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Access DB# 101188

SEARCH REQUEST FORM

Scientific and Technical Information Center

Requester's Full Name: Wesley Markham Examiner #: 78552 Date: 8/14/03
Art Unit: 1762 Phone Number 30 8-7557 Serial Number: 10/019,278
Mail Box and Bldg/Room Location: CP3 10A15 Results Format Preferred (circle): PAPER DISK E-MAIL

If more than one search is submitted, please prioritize searches in order of need.

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Please provide a detailed statement of the search topic, and describe as specifically as possible the subject matter to be searched. Include the elected species or structures, keywords, synonyms, acronyms, and registry numbers, and combine with the concept or utility of the invention. Define any terms that may have a special meaning. Give examples or relevant citations, authors, etc, if known. Please attach a copy of the cover sheet, pertinent claims, and abstract.

Title of Invention: Method + Device For ECR plasma deposition of carbon nanofib layer

Inventors (please provide full names): Marc Delaunay } from Commissariat
Marie-Noelle Semeria } a l'energie atomique

Earliest Priority Filing Date: 7/1/1999

***For Sequence Searches Only* Please include all pertinent information (parent, child, divisional, or issued patent numbers) along with the appropriate serial number.**

Please search claims 27-40. For an electron cyclotron resonance (ECR) plasma CVD method of depositing carbon nanotubes onto a substrate. Preferably ① substrate does not have any catalyst, ② power for CVD is microwave and ③ ECR chamber has magnetic mirror.

nanotube synonyms: nanofiber, nanofibre, CNT, MWNT, SWNT MWCNT, SWCNT, buckytube, Fullerene tube, nanofilament

Thanks a lot,
Wes

Index Search + Dialog

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STAFF USE ONLY	**Type of Search**	**Vendors and cost where applicable**
Searcher: J Cole	NA Sequence (#)	STN ✓
Searcher Phone #:	AA Sequence (#)	Dialog
Searcher Location:	Structure (#)	Questel/Orbit
Date Searcher Picked Up: 8/19/03	Bibliographic ✓	Dr.Link
Date Completed: 8/19/03	Litigation	Lexis/Nexis
Searcher Prep & Review Time: 60	Fulltext	Sequence Systems
Clerical Prep Time:	Patent Family	WWW/Internet
Online Time: 60	Other	Other (specify)

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=> file hca

FILE 'HCA' ENTERED AT 14:10:30 ON 19 AUG 2003
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=> d his nofile

     (FILE 'HOME' ENTERED AT 13:35:06 ON 19 AUG 2003)

     FILE 'LCA' ENTERED AT 13:35:10 ON 19 AUG 2003
L1            1 SEA ABB=ON  PLU=ON  NANOTUB? OR SWNT OR MWNT OR SWCNT OR CNT
                OR BUCKYTUB? OR (FULLERENE# OR NANO#)(2A)(TUB? OR FIBER# OR
                PIP##### OR FILAMENT?) OR NANOPIP? OR NANOFILAMENT? OR
                NANOFIBER? OR NANOFIBRE?

     FILE 'HCA' ENTERED AT 13:36:44 ON 19 AUG 2003
L2        12205 SEA ABB=ON  PLU=ON  NANOTUB? OR SWNT OR MWNT OR SWCNT OR CNT
                OR BUCKYTUB? OR (FULLERENE# OR NANO#)(2A)(TUB? OR FIBER# OR
                PIP##### OR FILAMENT?) OR NANOPIP? OR NANOFILAMENT? OR
                NANOFIBER? OR NANOFIBRE?
L3       107157 SEA ABB=ON  PLU=ON  (ELECTRON# OR CYCLOTRON?)(2A)RESONANC? OR
                ECR
L4           92 SEA ABB=ON  PLU=ON  L2 AND L3
L5       723974 SEA ABB=ON  PLU=ON  PLASMA?

     FILE 'LCA' ENTERED AT 13:38:42 ON 19 AUG 2003
L6           62 SEA ABB=ON  PLU=ON  CVD OR (CHEMICAL? OR CHEM)(2A)(VAPOR? OR
                VAPOUR?)(2A)DEPOSIT? OR OMCVD OR MOCVD OR LPCVD OR PECVD OR
                HFCVD OR ULPCVD OR PACVD OR PCVD
L7          115 SEA ABB=ON  PLU=ON  MIRROR?
L8          206 SEA ABB=ON  PLU=ON  MICROWAV?
L9         2958 SEA ABB=ON  PLU=ON  CHAMBER? OR COMPARTMENT? OR CAVIT? OR
                REACTOR? OR VESSEL? OR HOUS?

     FILE 'HCA' ENTERED AT 13:43:23 ON 19 AUG 2003
L10       91167 SEA ABB=ON  PLU=ON  CVD OR (CHEMICAL? OR CHEM)(2A)(VAPOR? OR
                VAPOUR?)(2A)DEPOSIT? OR OMCVD OR MOCVD OR LPCVD OR PECVD OR
                HFCVD OR ULPCVD OR PACVD OR PCVD
L11       49649 SEA ABB=ON  PLU=ON  MIRROR?
L12       83741 S L8
L13     1009393 SEA ABB=ON  PLU=ON  CHAMBER? OR COMPARTMENT? OR CAVIT? OR
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                 REACTOR? OR VESSEL? OR HOUS?
L14           43 SEA ABB=ON  PLU=ON  L4 AND 1907-1999/PY,PRY
L15            2 SEA ABB=ON  PLU=ON  L14 AND L6
L16            6 SEA ABB=ON  PLU=ON  L14 AND L12
L17            1 SEA ABB=ON  PLU=ON  L14 AND L9
L18            6 SEA ABB=ON  PLU=ON  L15 OR L16 OR L17
L19         1669 SEA ABB=ON  PLU=ON  (COMMISSARIAT? AND FR#)/PA
L20            1 SEA ABB=ON  PLU=ON  L18 AND L19
L21            1 SEA ABB=ON  PLU=ON  L14 AND L19
                 D SCAN
L22            5 SEA ABB=ON  PLU=ON  L18 NOT L21
L23           37 SEA ABB=ON  PLU=ON  L14 NOT L18
L24            1 SEA ABB=ON  PLU=ON  L14 AND L13
L25              QUE ABB=ON  PLU=ON  PRODUC? OR PROD# OR GENERAT? OR MANUF? OR
                 MFR# OR CREAT? OR FORM## OR FORMING# OR FORMAT? OR MAKE# OR
                 MADE# OR MAKING# OR FABRICAT? OR SYNTHESI? OR PREPAR? OR PREP#
L26           18 SEA ABB=ON  PLU=ON  L23 AND L25
L27           16 SEA ABB=ON  PLU=ON  L26 AND ESR#
L28      1460462 SEA ABB=ON  PLU=ON  FABRIC? OR TEXTILE? OR CLOTH? OR TARN? OR
                 WEAV? OR WOVE? OR WOOF? OR WEFT? OR WEB? OR WEB? OR SPIN? OR
                 SPUN? OR FIBER?
L29           16 SEA ABB=ON  PLU=ON  L26 AND L28
L30           16 SEA ABB=ON  PLU=ON  L29 OR L27
L31           16 SEA ABB=ON  PLU=ON  L30 NOT L18

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L32         6154 SEA ABB=ON  PLU=ON  L3
L33         3635 SEA ABB=ON  PLU=ON  L1
                 SET MSTEPS ON
L34            3 SEA ABB=ON  PLU=ON  L32 AND L33
L35            5 SEA ABB=ON  PLU=ON  L32 AND L33
     TOTAL FOR ALL FILES
L36            8 SEA ABB=ON  PLU=ON  L32 AND L33
                 D SCAN
L37            3 SEA ABB=ON  PLU=ON  L34 AND 2001-2003/PY,PRY
L38            5 SEA ABB=ON  PLU=ON  L35 AND 2001-2003/PY,PRY
     TOTAL FOR ALL FILES
L39            8 SEA ABB=ON  PLU=ON  L36 AND 2001-2003/PY,PRY
                 SET MSTEPS OFF
L40        55560 SEA ABB=ON  PLU=ON  L6
L41          153 SEA ABB=ON  PLU=ON  L1 AND L40
L42      3654439 SEA ABB=ON  PLU=ON  PRODUC? OR FABRIC? OR SYNTHE? OR MFR#
L43           91 SEA ABB=ON  PLU=ON  L41 AND L42
L44           23 SEA ABB=ON  PLU=ON  L43 AND L9
L45            8 SEA ABB=ON  PLU=ON  L44 AND L8
L46            7 SEA ABB=ON  PLU=ON  L44 AND L28
L47           16 SEA ABB=ON  PLU=ON  L39 OR L45 OR L46

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L48        11412 SEA ABB=ON  PLU=ON  L1
L49        52691 SEA ABB=ON  PLU=ON  L3
L50          125 SEA ABB=ON  PLU=ON  L48 AND L49
L51           41 SEA ABB=ON  PLU=ON  L50 AND 1985-1999/PY
L52        39273 SEA ABB=ON  PLU=ON  L6
L53        96811 SEA ABB=ON  PLU=ON  L6
L54       975215 SEA ABB=ON  PLU=ON  L28
L55       215051 SEA ABB=ON  PLU=ON  L8
L56      2355278 SEA ABB=ON  PLU=ON  L42
L57            0 SEA ABB=ON  PLU=ON  L51 AND L6
L58            2 SEA ABB=ON  PLU=ON  L51 AND L53
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L59          29 SEA ABB=ON  PLU=ON  L51 AND L54
L60           1 SEA ABB=ON  PLU=ON  L59 AND L55
L61          10 SEA ABB=ON  PLU=ON  L59 AND L56
L62          12 SEA ABB=ON  PLU=ON  L58 OR L60 OR L61
                D SCAN
L63           8 SEA ABB=ON  PLU=ON  L62 AND ESR
L64          18 SEA ABB=ON  PLU=ON  L48 AND ECR
L65          40 SEA ABB=ON  PLU=ON  L51 NOT L64
L66          17 SEA ABB=ON  PLU=ON  L64 NOT L51
L67          16 SEA ABB=ON  PLU=ON  L66 AND (L53 OR L54 OR L55 OR L56)
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FILE 'HCA' ENTERED AT 14:10:30 ON 19 AUG 2003

=> d L21 cbib abs hitind

L21 ANSWER 1 OF 1 HCA COPYRIGHT 2003 ACS on STN

134:93659 Method and device for electronic **cyclotronic resonance** plasma deposit of carbon **nanofibre** layers in fabric form and resulting fabric layers. Delaunay, Marc; Semeria, Marie-Noelle (**Commissariat a l'Energie Atomique, Fr.**). PCT Int. Appl. WO 2001003158 A1 20010111, 51 pp. DESIGNATED STATES: W: JP, US; RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE. (French). CODEN: PIXXD2. APPLICATION: WO 2000-FR1827 20000629. PRIORITY: FR 1999-8473 19990701.

AB The invention concerns a method and a device for electronic **cyclotronic resonance** plasma deposit of carbon **nanofibres** or **nanotubes** in fabric form, on a catalyst-free substrate, by microwave power injection into a deposit chamber comprising a magnetic structure with a highly unbalanced magnetic mirror, and at least an electronic **cyclotronic resonance** inside said deposit chamber itself and opposite said substrate, whereby, under pressure less than 10-4 mbar, the carbon-contg. gas in said magnetic mirror at the center of the deposit chamber is ionised and/or dissocd., thereby producing species which will be deposited on said substrate which is heated. The invention further concerns a layer, optionally on a substrate, formed of a fabric or array of carbon **nanofibres** or **nanotubes** interconnected as in a web, said layer being catalyst-free and having multiple layers-or a multilayer structure - comprising at least two layers of carbon **nanofibres** or **nanotubes** in fabric form, and filters, nanogrids accelerating or decelerating electrons and flat displays comprising such layers or structures.

IC ICM H01J037-32
ICS H05H001-46; C01B031-02

CC 75-1 (Crystallography and Liquid Crystals)
Section cross-reference(s): 74, 76

ST **electron cyclotron resonance** plasma deposition carbon **nanofiber** layer fabric; method app **ECR** plasma deposition carbon **nanofiber** layer fabric

IT **Nanotubes**
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(carbon; method and device for electronic **cyclotronic resonance** plasma deposit of carbon **nanofiber** layers in fabric form and resulting fabric layers)

IT Optical imaging devices
(flat screens; method and device for electronic **cyclotronic resonance** plasma deposit of carbon **nanofiber** layers in fabric form and resulting fabric layers for)

IT Textiles

(method and device for electronic **cyclotronic resonance** plasma deposit of carbon **nanofiber** layers in fabric form and resulting fabric layers)
IT Carbon fibers, properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method and device for electronic **cyclotronic resonance** plasma deposit of carbon **nanofiber** layers in fabric form and resulting fabric layers)
IT Vapor deposition process
(plasma; method and device for electronic **cyclotronic resonance** plasma deposit of carbon **nanofiber** layers in fabric form and resulting fabric layers)
IT 74-82-8, Methane, processes 74-84-0, Ethane, processes 74-85-1, Ethene, processes 74-86-2, Acetylene, processes 1333-74-0, Hydrogen, processes
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(method and device for electronic **cyclotronic resonance** plasma deposit of carbon **nanofiber** layers in fabric form and resulting fabric layers)

=> d L22 1-5 cbib abs hitind

L22 ANSWER 1 OF 5 HCA COPYRIGHT 2003 ACS on STN
136:159188 Process for synthesizing one-dimensional nanosubstances by **electron cyclotron resonance chemical vapor deposition**. Shih, Han-Chang; Sung, Shing-Li; Tsai, Shang-Hua (Taiwan). U.S. US 6346303 B1 20020212, 12 pp. (English). CODEN: USXXAM. APPLICATION: US 1999-311598 19990514. PRIORITY: TW 1999-88100434 19990111.
AB The present invention provides a process for synthesizing 1-dimensional nanosubstances. A membrane having channels serves as the host material for the synthesis. The anodic membrane is brought into contact with a **microwave** excited plasma of a precursor gas using an **electron cyclotron resonance CVD** (**ECR-CVD**) system. Parallel aligned nanosubstances can be synthesized in the channels of the membrane over a large area. C nitride nanosubstances are synthesized successfully for the 1st time in the present invention.
IC ICM H05H001-18
ICS C23C016-32; C23C016-36
NCL 427571000
CC 75-1 (Crystallography and Liquid Crystals)
Section cross-reference(s): 57
ST carbon nanosubstance one dimensional synthesis **electron cyclotron resonance CVD**; nitride carbon **nanotube** synthesis **electron cyclotron resonance CVD**; **nanofiber** carbon synthesis **electron cyclotron resonance CVD**
IT **Electron cyclotron resonance**
(**CVD**; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)
IT **Nanotubes**
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(carbon fibers; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)
IT Hydrocarbons, processes

RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
(carbon source; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)

IT **Nanotubes**
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(carbon; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)

IT **Vapor deposition** process
(**chem.**, **electron cyclotron resonance**; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)

IT Polymers, uses
RL: DEV (Device component use); USES (Uses)
(membrane; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD** including step of contacting membrane with MW excited plasma gas)

IT Carbon fibers, processes
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(**nanotube**; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)

IT Nanostructures
(process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)

IT 7439-90-9, Krypton, uses 7440-01-9, Neon, uses 7440-37-1, Argon, uses 7440-59-7, Helium, uses 7440-63-3, Xenon, uses
RL: NUU (Other use, unclassified); USES (Uses)
(activating gas; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)

IT 1344-28-1, Alumina, uses 7631-86-9, Silica, uses
RL: DEV (Device component use); USES (Uses)
(membrane; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD** including step of contacting membrane with MW excited plasma gas)

IT 7664-41-7, Ammonia, processes 7727-37-9, Nitrogen, processes
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
(nitrogen source; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)

IT 154769-61-6P, Carbon nitride
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)

L22 ANSWER 2 OF 5 HCA COPYRIGHT 2003 ACS on STN

130:162353 Well-aligned carbon nitride **nanotubes** synthesized in anodic alumina by **electron cyclotron resonance chemical vapor deposition**. Sung, S. L.; Tsai, S. H.; Tseng, C. H.; Chiang, F. K.; Liu, X. W.; Shih, H. C. (Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu, 300, Taiwan). Applied Physics Letters, 74(2), 197-199 (English) **1999**. CODEN: APPLAB. ISSN: 0003-6951. Publisher: American Institute of Physics.

AB Vertically aligned C nitride **nanotubes** with a uniform diam. of

.apprx.250 nm were synthesized on a porous alumina membrane template (50-80 .mu.m thick) in a **microwave** excited plasma of C2H2 and N2 using an **electron cyclotron resonance**
CVD system. A neg. d.c. bias voltage was applied to the substrate holder of graphite to promote the flow of ionic fluxes through the nanochannels of the alumina template. This allowed the phys., and subsequent chem., absorption of species on the walls of the nanochannels that gave the C nitride **nanotubes**. The hollow structure and vertically aligned properties of the **nanotubes** were clearly verified by field-emission scanning electron microscope images. The absorption band between 1250 and 1750 cm-1 in the FTIR spectroscopy spectrum proves that N atoms were incorporated into an amorphous network of C.

CC 78-8 (Inorganic Chemicals and Reactions)
ST carbon nitride **nanotube** prepn alumina substrate
IT **Vapor deposition** process
(**chem.**, infiltration; well-aligned carbon nitride **nanotubes** synthesized in anodic alumina by **electron cyclotron resonance chem. vapor deposition**)
IT **Electron cyclotron resonance**
Nanotubes
(well-aligned carbon nitride **nanotubes** synthesized in anodic alumina by **electron cyclotron resonance chem. vapor deposition**)
IT 74-86-2, Acetylene, reactions 7727-37-9, Nitrogen, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(reactant; well-aligned carbon nitride **nanotubes** synthesized in anodic alumina by **electron cyclotron resonance chem. vapor deposition**)
IT 1344-28-1, Alumina, uses
RL: NUU (Other use, unclassified); USES (Uses)
(well-aligned carbon nitride **nanotubes** synthesized in anodic alumina by **electron cyclotron resonance chem. vapor deposition**)
IT 154769-61-6P, Carbon nitride
RL: SPN (Synthetic preparation); PREP (Preparation)
(well-aligned carbon nitride **nanotubes** synthesized in anodic alumina by **electron cyclotron resonance chem. vapor deposition**)

L22 ANSWER 3 OF 5 HCA COPYRIGHT 2003 ACS on STN
129:116088 Electronic properties of single wall carbon **nanotubes**.
Petit, P.; Jouguelet, E.; Parizel, N.; Fischer, J. E.; Thess, A.; Smalley, R. E. (Institut Charles Sadron, Strasbourg, 67000, Fr.). Molecular Nanostructures, Proceedings of the International Winterschool on Electronic Properties of Novel Materials, 11th, Kirchberg, Austria, Mar. 1-8, 1997, Meeting Date 1997, 435-438. Editor(s): Kuzmany, Hans. World Scientific: Singapore, Singapore. (English) **1998**. CODEN: 66BSA7.
AB We report ESR and **microwave** resistivity measurements vs. T on bulk single wall carbon **nanotubes**. The results show that metallic resistivity is an intrinsic property of the material even at low temp. where d.rho./dT is neg. The data is consistent with one dimensional electronic transport.
CC 76-1 (Electric Phenomena)
ST electronic property single wall carbon **nanotube**
IT ESR (**electron** spin **resonance**)
Microwave
(ESR and **microwave** resistivity measurements vs. temp. on bulk

single wall carbon **nanotubes**)
IT **Nanotubes**
RL: PRP (Properties)
(carbon; electronic properties of single wall carbon **nanotubes**
)
IT Electronic properties
(electronic properties of single wall carbon **nanotubes**)
IT 7440-44-0, Carbon, uses
RL: DEV (Device component use); USES (Uses)
(**nanotubes**; electronic properties of single wall carbon
nanotubes)

L22 ANSWER 4 OF 5 HCA COPYRIGHT 2003 ACS on STN
128:55740 **Electron** spin **resonance** and **microwave**
resistivity of single-wall carbon **nanotubes**. Petit, P.;
Jouguelet, E.; Fischer, J. E.; Rinzler, A. G.; Smalley, R. E. (Institut
Charles Sadron, 6, rue Boussingault, Strasbourg, 67000, Fr.). Physical
Review B: Condensed Matter, 56(15), 9275-9278 (English) **1997**.
CODEN: PRBMDO. ISSN: 0163-1829. Publisher: American Physical Society.
AB The thermal variations of ESR, d.c. resistivity and **microwave**
resistivity of unoriented bulk single-wall carbon **nanotubes** were
compared. The metallic high-temp. behavior involving a pos. temp. coeff.
of elec. resistivity is an intrinsic property of the bulk carbon, and the
system remains metallic even at low temps. and neg. temp. coeff. of
resistivity. The spin susceptibility is also independent of temp., and a
long mean-free path implies transport predominantly along the tube axes in
the bulk.
CC 76-1 (Electric Phenomena)
Section cross-reference(s): 77
ST carbon **nanotube microwave** resistivity ESR
IT ESR (**electron** spin **resonance**)
(ESR and **microwave** resistivity of single-wall carbon
nanotubes)
IT **Nanotubes**
RL: PRP (Properties)
(carbon; ESR and **microwave** resistivity of single-wall carbon
nanotubes)
IT Electric resistance
(d.c. and **microwave**; ESR and **microwave** resistivity
of single-wall carbon **nanotubes**)
IT **Microwave**
(resistivity; ESR and **microwave** resistivity of single-wall
carbon **nanotubes**)
IT 7440-44-0, Carbon, properties
RL: PRP (Properties)
(ESR and **microwave** resistivity of single-wall carbon
nanotubes)

L22 ANSWER 5 OF 5 HCA COPYRIGHT 2003 ACS on STN
127:256553 ESR and **microwave** resistivity studies of single wall
carbon **nanotubes**. Petit, P.; Jouguelet, E.; Fischer, J. E.;
Thess, A.; Smalley, R. E. (Institut Charles Sadron, Strasbourg, 67000,
Fr.). Proceedings - Electrochemical Society, 97-14(Recent Advances in the
Chemistry and Physics of Fullerenes and Related Materials), 1151-1156
(English) **1997**. CODEN: PESODO. ISSN: 0161-6374. Publisher:
Electrochemical Society.
AB The authors report ESR, d.c. and 10 GHz resistivity measurements on Single
Wall C **Nanotubes**. The measured resistivity is intrinsic to the
unoriented bulk material which is metallic down to low temps., and
strongly suggest that electronic transport occurs along the

nanotube axis.
CC 77-6 (Magnetic Phenomena)
Section cross-reference(s): 76
ST carbon **nanotube** ESR resistance; magnetic relaxation carbon **nanotube**; electron diffusion carbon **nanotube**
IT ESR (**electron** spin **resonance**)
Electric resistance
Ferromagnetic resonance
Spin-spin relaxation
(ESR and **microwave** resistivity of single-wall carbon **nanotubes**)
IT Annealing
(annealing removal of cobalt and nickel from carbon **nanotubes**)
IT **Nanotubes**
RL: PRP (Properties)
(carbon; ESR and **microwave** resistivity of single-wall carbon **nanotubes**)
IT Conduction electrons
(diffusion; in single-wall carbon **nanotubes**)
IT 7440-44-0, Carbon, properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(ESR and **microwave** resistivity of single-wall carbon **nanotubes**)
IT 7440-02-0, Nickel, processes 7440-48-4, Cobalt, processes
RL: OCU (Occurrence, unclassified); REM (Removal or disposal); OCCU (Occurrence); PROC (Process)
(annealing removal of cobalt and nickel from carbon **nanotubes**)

=> d L30 1-16 cbib abs hitind

L30 ANSWER 1 OF 16 HCA COPYRIGHT 2003 ACS on STN
132:101782 **Electron spin resonance** of purified carbon **nanotubes**. Zhan, Yehong (Dep. Mathematics and Physics, Guangdong Univ. Technology, Canton, 510090, Peop. Rep. China). Huaxue Wuli Xuebao, 12(5), 575-578 (Chinese) **1999**. CODEN: HWXUE4. ISSN: 1003-7713. Publisher: Kexue Chubanshe.
AB The carbon **nanotubes** were **produced** by d.c. arc-discharge method through helium and argon gas resp. at a controlled pressure. The crude **nanotubes** were oxidized at 770.degree. until .apprx.1% of the wt. remained and the purified **nanotubes** were obtained. The **ESR** spectrum of purified carbon **nanotubes prepd**. under different inert gases and their pressures were measured. The dependence of the **ESR** line shape, linewidth, g value of the purified **nanotubes** on the inert gases and their pressures is found and discussed.
CC 77-6 (Magnetic Phenomena)
ST **ESR** purified carbon **nanotube**
IT **ESR** (**electron spin resonance**)
(**ESR** of purified carbon **nanotubes**)
IT **Nanotubes**
RL: PRP (Properties)
(carbon; **ESR** of purified carbon **nanotubes**)

L30 ANSWER 2 OF 16 HCA COPYRIGHT 2003 ACS on STN
131:280415 Reduction and **creation** of paramagnetic centers on surfaces of three different polytypes of SiC. Macfarlane, P. J.; Zvanut,

M. E. (Department of Physics, University of Alabama at Birmingham, Birmingham, AL, 35294-1170, USA). Journal of Vacuum Science & Technology, B: Microelectronics and Nanometer Structures, 17(4), 1627-1631 (English) **1999**. CODEN: JVTBD9. ISSN: 0734-211X. Publisher: American Institute of Physics.

AB SiC is of interest to **create** power metal-oxide-semiconductor field-effect transistors because it can be thermally oxidized to **form** a SiO2 dielec. layer. Previously, the authors used **ESR** to identify centers in 3C-SiC epilayer samples and 4H-SiC and 6H-SiC wafer samples after oxidn. and dry heat treatment [P. J. Macfarlane and M. E. Zvanut, Appl. Phys. Lett. 71, 2148(1997); Mater. Res. Soc. Symp. Proc. 513, 433(1998)]. The spectroscopic and thermal characteristics of these centers indicate that they are related to C. Because these centers are activated in a H2O-poor ambient and are passivated in an ambient that is H2O-rich, probably the activation mechanism is release of a hydrogenous species. The effect of repeated oxidns. on the concn. of heat-treatment-induced centers was studied. Samples are successively oxidized at 1150.degree. in O2 bubbled through de-ionized water for 1, 2, 4, 8, and 16 h. After each oxidn., the samples are heat treated in dry (<0.1 ppm H2O) N2. Prior to the next oxidn., the oxide is removed. Upon oxidn. of the samples the authors observe an order of magnitude redn. in the concn. of centers that are present on the as-**prepd**. substrates. After each oxidn. centers are activated by dry heat treatment. Probably the centers present on the as-**prepd**. substrates are related to surface damage and are removed during the oxidn. as the surface SiC material is converted in the oxidn. **products**. Two models are offered for the source of the centers **generated** by dry heat treatment. The centers could be activated from C-H bonds related to damage like micropipes, **nanopipes**, or Si vacancies distributed throughout the SiC substrate, or they could arise from C-H bonds that **form** during the oxidn. The authors will discuss the merits of both of these models.

CC 77-6 (Magnetic Phenomena)
Section cross-reference(s): 76

ST silicon carbide polytype MOSFET **ESR** paramagnetic center

IT **ESR (electron spin resonance)**
MOSFET (transistors)
Paramagnetic centers
Passivation
Polytypism
(redn. and **creation** of paramagnetic centers on surfaces of three different polytypes of SiC polytypes for MOSFET)

IT 409-21-2, Silicon carbide, properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(redn. and **creation** of paramagnetic centers on surfaces of three different polytypes of SiC polytypes for MOSFET)

L30 ANSWER 3 OF 16 HCA COPYRIGHT 2003 ACS on STN

131:152846 Effect of different inert gases and pressures on the **electron spin resonance** of carbon **nanotubes**. Zhang, Hai-Yan; He, Yan-Yang; Xue, Xin-Min; Liang, Li-Zheng; Wang, Jing (Dep. Mathematics Phys., Guangdong Univ. Technol., Canton, 510090, Peop. Rep. China). Wuli Xuebao, 48(7), 1354-1360 (Chinese) **1999**. CODEN: WLHPAR. ISSN: 1000-3290. Publisher: Zhongguo Kexueyuan Wuli Yanjiuso.

AB The **nanotubes** were **produced** by d.c. arc-discharge method through helium and argon gas at a controlled pressure ranging from 10 kPa to 80 kPa. The crude **nanotubes** were oxidized at 770.degree. until .apprx.1% of the wt. remained and the purified

nanotubes were obtained. The **ESR** of purified carbon
nanotubes prepd. under different inert gases with
different pressures was measured. The dependence of **ESR** line
shape, line-width, g value and **spin** d. of the purified
nanotubes on different inert gases and pressure is found and
discussed.
CC 77-6 (Magnetic Phenomena)
ST carbon **nanotube ESR** inert gas pressure effect
IT **Nanotubes**
RL: PRP (Properties)
(carbon; effect of different inert gases and pressures on the
ESR of carbon **nanotubes**)
IT **ESR (electron spin resonance)**
(effect of different inert gases and pressures on the **ESR** of
carbon **nanotubes**)
IT Noble gases, properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties); RCT
(Reactant); PROC (Process); RACT (Reactant or reagent)
(effect of different inert gases and pressures on the **ESR** of
carbon **nanotubes**)
IT 7440-37-1, Argon, properties 7440-59-7, Helium, properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties); RCT
(Reactant); PROC (Process); RACT (Reactant or reagent)
(effect of different inert gases and pressures on the **ESR** of
carbon **nanotubes**)

L30 ANSWER 4 OF 16 HCA COPYRIGHT 2003 ACS on STN
130:216606 Morphology and electronic properties of carbon **nanotubes**
synthesized by arc discharge in CF4 gas. Yokomichi, H.; Sakima,
H.; Matoba, M.; Ichihara, M.; Sakai, F. (Department of Electronics and
Informatics, Toyama Prefectural University, Kosugi, 939-0398, Japan).
Superlattices and Microstructures, 25(1/2), 487-491 (English) **1999**
. CODEN: SUMIEK. ISSN: 0749-6036. Publisher: Academic Press.
AB The morphol. of C **nanotubes synthesized** by arc
discharge in a CF4 gas atm. was studied by SEM and TEM. The electronic
properties of these **nanotubes** were studied by **ESR**.
The **synthesis** conditions in CF4 gas were then compared with
those in CH4, H2 and He based on these results. Also, the mechanism of
tube growth in CF4 gas was discussed briefly. (c) 1999 Academic Press.
CC 76-11 (Electric Phenomena)
Section cross-reference(s): 78
ST carbon **nanotube** electronic property morphol arc discharge
IT **Nanotubes**
RL: PEP (Physical, engineering or chemical process); PNU (Preparation,
unclassified); PRP (Properties); PREP (Preparation); PROC (Process)
(carbon; morphol. and electronic properties of carbon **nanotubes**
synthesized by arc discharge in CF4 gas)
IT Electric arc
Electronic properties
(morphol. and electronic properties of carbon **nanotubes**
synthesized by arc discharge in CF4 gas)
IT **ESR (electron spin resonance)**
Scanning electron microscopy
Transmission electron microscopy
(study on morphol. and electronic properties of carbon
nanotubes by SEM, TEM and **ESR**)
IT 75-73-0, Carbon fluoride (CF4)
RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC
(Process); RACT (Reactant or reagent)
(morphol. and electronic properties of carbon **nanotubes**

synthesized by arc discharge in CF4 gas)

L30 ANSWER 5 OF 16 HCA COPYRIGHT 2003 ACS on STN
130:147237 **Synthesis** of carbon **nanotubes** by arc-discharge in CF4-gas atmosphere. Yokomichi, Haruo; Matoba, Masaaki; Sakima, Hiroyuki; Ichihara, Masaki; Sakai, Fumiko (Department of Electronics and Informatics, Toyama Prefectural University, Toyanea, 939-0398, Japan). Japanese Journal of Applied Physics, Part 1: Regular Papers, Short Notes & Review Papers, 37(12A), 6492-6496 (English) **1998**. CODEN: JAPNDE. ISSN: 0021-4922. Publisher: Japanese Journal of Applied Physics.

AB Carbon **nanotubes** were **synthesized** by arc discharge in a CF4 gas atm. involving fluorine atoms, which are able to terminate carbon bonding, while no fullerenes were **synthesized** in a CF4 gas atm. The morphol. of these **nanotubes** was investigated by SEM and transmission electron microscopy (TEM). Based on these results, the **synthesized** conditions in CF4 gas were compared with those in other gases, i.e., in CH4, H2, He and Ar gases. In addn., **ESR** (**ESR**) measurements were performed in order to obtain information about the electronic properties of these **nanotubes**.

CC 76-11 (Electric Phenomena)

ST carbon **nanotube synthesis** arc discharge tetrafluoromethane

IT **Nanotubes**
RL: PNU (Preparation, unclassified); PRP (Properties); PREP (Preparation)
(carbon; **synthesis** of carbon **nanotubes** by arc discharge in CF4 gas atm.)

IT **ESR (electron spin resonance)**
Electric arc
Electronic properties
Scanning electron microscopy
Transmission electron microscopy
(**synthesis** of carbon **nanotubes** by arc discharge in CF4 gas atm.)

IT 75-73-0, Carbon fluoride (CF4)
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(**synthesis** of carbon **nanotubes** by arc discharge in CF4 gas atm.)

IT 7440-44-0P, Carbon, properties
RL: PNU (Preparation, unclassified); PRP (Properties); PREP (Preparation)
(**synthesis** of carbon **nanotubes** by arc discharge in CF4 gas atm.)

L30 ANSWER 6 OF 16 HCA COPYRIGHT 2003 ACS on STN
130:9819 **ESR** of purified carbon **nanotubes produced** under different helium pressures. Wong, S. P.; Zhang, Haiyan; Ke, Ning; Peng, Shaoqi (Department of Electronic Engineering, The Chinese University of Hong Kong, Hong Kong, Peop. Rep. China). Materials Research Society Symposium Proceedings, 497(Recent Advances in Catalytic Materials), 151-156 (English) **1998**. CODEN: MRSPDH. ISSN: 0272-9172. Publisher: Materials Research Society.

AB Carbon **nanotubes** were **prepd**. by the dc arc-discharge method under a controlled helium pressure ranging from 10 to 80 kPa and subsequently purified by oxidn. in air. The purified carbon **nanotubes** were obsd. by TEM. The room temp. **ESR** spectra of the purified **nanotubes** were measured. The variations in the **ESR** line shape, g-value, linewidth and relative **spin** d. of the purified **nanotubes** on helium pressure were studied and discussed.

CC 77-6 (Magnetic Phenomena)

ST carbon **nanotube ESR** helium pressure
IT Controlled atmospheres
ESR (electron spin resonance)
Transmission electron microscopy
g-factor
(**ESR** of purified carbon **nanotubes produced** under different helium pressures)
IT **Nanotubes**
Nanotubes
RL: PRP (Properties)
(carbon **fibers; ESR** of purified carbon **nanotubes produced** under different helium pressures)
IT **Nanotubes**
RL: PRP (Properties)
(carbon; **ESR** of purified carbon **nanotubes produced** under different helium pressures)
IT Carbon **fibers**, properties
Carbon **fibers**, properties
RL: PRP (Properties)
(**nanotube; ESR** of purified carbon **nanotubes produced** under different helium pressures)
IT 7440-59-7, Helium, uses
RL: MSC (Miscellaneous); TEM (Technical or engineered material use); USES (Uses)
(**ESR** of purified carbon **nanotubes produced** under different helium pressures)
IT 7440-44-0, Carbon, properties
RL: PRP (Properties)
(**nanotubes; ESR** of purified carbon **nanotubes produced** under different helium pressures)

L30 ANSWER 7 OF 16 HCA COPYRIGHT 2003 ACS on STN
129:325184 Effects of different inert gas ambient on the **formation** and **ESR** spectra of carbon **nanotubes**. Wong, S. P.; Zhang, Haiyan; Ke, Ning; Peng, Shaoqi (Dept. of Electronic Engineering, The Chinese University of Hong Kong, Hong Kong, Peop. Rep. China). Proceedings - Electrochemical Society, 98-8(Recent Advances in the Chemistry and Physics of Fullerenes and Related Materials), 1312-1321 (English) **1998**. CODEN: PESODO. ISSN: 0161-6374. Publisher: Electrochemical Society.
AB Carbon **nanotubes** were **prepd**. by the d.c. arc-discharge method under a controlled helium or argon pressure ranging from 10 to 80 kPa and obsd. by TEM. Purifn. of the **nanotubes** were performed by oxidn. in air at 770.degree. until .apprx.1% of the initial wt. remained. The room temp. **ESR** spectra of the crude and purified **nanotubes** were measured. The variations with the He or Ar pressure in the size distribution of the crude carbon **nanotubes** from TEM observations were compared, and the variations in the **ESR** parameters with the gas ambient and pressure were studied.
CC 78-1 (Inorganic Chemicals and Reactions)
ST carbon **nanotube prepn ESR** diam distribution; **ESR** carbon **nanotube** helium argon effect; diam distribution **nanotube** helium argon effect; argon effect carbon **nanotube** diam distribution; helium effect carbon **nanotube** diam distribution
IT **Nanotubes**
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)
(carbon; effects of different inert gas ambient on **formation**, **ESR** spectra and diam. distribution of carbon **nanotubes**)

IT **ESR (electron spin resonance)**
Size distributions
(effects of different inert gas ambient on **formation**, **ESR** spectra and diam. distribution of carbon **nanotubes**)
IT 7440-37-1, Argon, uses 7440-59-7, Helium, uses
RL: NUU (Other use, unclassified); USES (Uses)
(effects of different inert gas ambient on **formation**, **ESR** spectra and diam. distribution of carbon **nanotubes**)

L30 ANSWER 8 OF 16 HCA COPYRIGHT 2003 ACS on STN
129:116884 **ESR** and NMR studies on Li- and Na-doped C60 compounds and lithiated carbon **nanotubes**. Menu, S.; Gaucher, H.; Conard, J.; Lauginie, P.; Nozhov, A.; Nalimova, V. A. (CRMD-CNRS, Orleans, 45071, Fr.). Molecular Nanostructures, Proceedings of the International Winterschool on Electronic Properties of Novel Materials, 11th, Kirchberg, Austria, Mar. 1-8, 1997, Meeting Date 1997, 262-265. Editor(s): Kuzmany, Hans. World Scientific: Singapore, Singapore. (English) **1998**. CODEN: 66BSA7.
AB Applying high pressure to mixts. of fullerene powders and alkali metal stoichiometric amts., the authors **synthesized** new alkali-C6060 compds., and Li carbon **nanotubes**. These compds. were studied using **ESR**, 7Li, 13C, an NMR spectroscopies. The authors' results on LixC60 compds. provide evidence of phases, with unexpectedly high alkali contents, up to .apprx.50 Li per C60 mol. The authors report also evidence of Li insertion between successive carbon sheets in multiwalled carbon **nanotubes**.
CC 77-6 (Magnetic Phenomena)
ST magnetic resonance lithium sodium doped fullerene; NMR lithium sodium doped fullerene; **ESR** lithium sodium doped fullerene
IT **ESR (electron spin resonance)**
NMR (nuclear magnetic resonance)
(**ESR** and NMR studies on Li- and Na-doped C60 compds. and lithiated carbon **nanotubes**)
IT Alkali metals, properties
RL: PRP (Properties)
(**ESR** and NMR studies on Li- and Na-doped C60 compds. and lithiated carbon **nanotubes**)
IT 7439-93-2, Lithium, uses 7440-23-5, Sodium, uses
RL: MOA (Modifier or additive use); USES (Uses)
(**ESR** and NMR studies on Li- and Na-doped C60 compds. and lithiated carbon **nanotubes**)
IT 99685-96-8, [5,6]Fullerene-C60-Ih 141326-56-9 141326-57-0
RL: PRP (Properties)
(**ESR** and NMR studies on Li- and Na-doped C60 compds. and lithiated carbon **nanotubes**)

L30 ANSWER 9 OF 16 HCA COPYRIGHT 2003 ACS on STN
129:61911 Purification and magnetic properties of carbon **nanotubes**. Bandow, S.; Asaka, S.; Zhao, X.; Ando, Y. (Japan Science Technology Corporation, Department Physics, Meijo University, Nagoya, 468, Japan). Applied Physics A: Materials Science & Processing, A67(1), 23-27 (English) **1998**. CODEN: APAMFC. ISSN: 0947-8396. Publisher: Springer-Verlag.
AB Purifn. procedures for both multi- (**MWNTs**) and single-wall C **nanotubes** (**SWNTs**) are introduced. Intermediate stages in the purifn. procedure are monitored by SEM, which clearly shows the increase of the **nanotube** content with increasing purifn. The magnetic properties were investigated by **ESR**. Two kinds of

samples were used in the **ESR** measurements for **MWNTs** and for **SWNTs**. One is dispersed in hexane to **make** loosely contacting tubules and the other is a dried-deposited tubule to realize a close contacting tubule state. The **ESR** lineshape is closely related to the contact between **nanotubes**. The curved nature of the tube wall plays an important role in the explanation of the **ESR** properties.

CC 78-1 (Inorganic Chemicals and Reactions)
Section cross-reference(s): 77

ST carbon **nanotube** purifn **ESR**

IT **Nanotubes**
RL: PRP (Properties); PUR (Purification or recovery); PREP (Preparation)
(carbon; purifn. of single-wall and multi-wall C **nanotubes** by centrifugation and microfiltration sepn. and heat treatment and their **ESR** spectra)

IT Filtration
(microfiltration; purifn. of single-wall and multi-wall C **nanotubes** by centrifugation and microfiltration sepn. and heat treatment and their **ESR** spectra)

IT Centrifugation
ESR (electron spin resonance)
Purification
(purifn. of single-wall and multi-wall C **nanotubes** by centrifugation and microfiltration sepn. and heat treatment and their **ESR** spectra)

L30 ANSWER 10 OF 16 HCA COPYRIGHT 2003 ACS on STN

128:175139 Carbon tubes discussed in a metallic ring model. Byszewski, Przemyslaw (Institute of Physics PAN, Warsaw, 02-668, Pol.). Journal of Physics and Chemistry of Solids, 58(11), 1685-1688 (English) **1997**. CODEN: JPCSAW. ISSN: 0022-3697. Publisher: Elsevier Science Ltd..

AB The similarity of the anisotropic properties of large diam. C tubes in a magnetic field to the anisotropy of graphite, suggests the use of a free electron model to describe their electronic structure in terms of the graphite band model. The diamagnetism of C tubes is discussed in terms of a model which accounts for the tubular deformation of graphite planes using the vector pseudopotential: Ad = h/.rho.2[-y,x,0], where .rho. is the radius of the tube orientated along the z-axis. The deformation of the plane splits the energy band in two with opposite angular momentum, confinement on the tube excludes Landau quantization, and instead the field **generates** a net ring current.

CC 77-1 (Magnetic Phenomena)

ST carbon **nanotube** anisotropy ring model; band structure carbon **nanotube**; magnetism carbon **nanotube**; **ESR** carbon **nanotube**

IT Anisotropy
Band structure
Diamagnetism
ESR (electron spin resonance)
Electronic state
Magnetic anisotropy
Magnetic field effects
Magnetic moment
Pseudopotential
(anisotropy of properties of carbon tubes in magnetic field)

IT **Nanotubes**
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(carbon; anisotropy of properties of carbon tubes in magnetic field)

L30 ANSWER 11 OF 16 HCA COPYRIGHT 2003 ACS on STN
128:134843 Experimental verification of the dominant influence of extended carbon networks on the structural, electrical and magnetic properties of a common soot. Dunne, L. J.; Nolan, P. F.; Munn, J.; Terrones, M.; Jones, T.; Kathirgamanathan, P.; Fernandez, J.; Hudson, A. D. (Chemical Engineering Research Centre, South Bank University, London, SE1 0AA, UK). Journal of Physics: Condensed Matter, 9(48), 10661-10673 (English) **1997**. CODEN: JCOMEL. ISSN: 0953-8984. Publisher: Institute of Physics Publishing.

AB Common soots are disordered carbonaceous materials contg. several percent of heteroatoms. A question of some importance is to what extent pure C networks dominate the properties of common soots. Here, the authors report the results of a comparative study of fullerene soots which are a **form** of pure partially ordered C and those **formed** from flaming polystyrene combustion which contain a few percent of O atoms, using electron diffraction, **ESR**, IR transmission and measurements of elec. cond. Despite some important characteristic differences, the annealed fullerene soot and flaming polystyrene soot have a no. of important structural, elec. and magnetic features in common, provided that the flame and annealing temps. are the same. Probably the graphitic layer and **fullerene** related **tubular** structures found in these materials dominate the elec. properties of these soots regardless of the presence of small quantities of heteroatoms in the soot derived from the flaming combustion of polystyrene.

CC 76-1 (Electric Phenomena)
Section cross-reference(s): 73, 77

ST soot carbon network structure cond magnetism; oxygen soot **ESR**; annealing fullerene soot property; optical absorption soot

IT Annealing
Combustion
ESR (electron spin resonance)
Electric conductivity
Flame
IR spectra
Optical absorption
Soot
Voids (structures)
(dominant influence of extended carbon networks on the structural, elec. and magnetic properties of a common soot)

IT Carbonaceous materials (technological **products**)
Fullerenes
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)
(dominant influence of extended carbon networks on the structural, elec. and magnetic properties of a common soot)

L30 ANSWER 12 OF 16 HCA COPYRIGHT 2003 ACS on STN
127:340956 Nanometer-size tubes of carbon. Ajayan, P. M.; Ebbesen, T. W. (Department of Materials Science and Engineering, Rensselaer Polytechnic Institute, Troy, NY, 12180-3590, USA). Reports on Progress in Physics, 60(10), 1025-1062 (English) **1997**. CODEN: RPPHAG. ISSN: 0034-4885. Publisher: Institute of Physics Publishing.

AB A review is presented on the present state of understanding of the structure, growth and properties of nanometer-size tubes of C with many refs. Two different types of C **nanotubes**, single-shell **nanotubes made** of single layers of graphene cylinders and multishell **nanotubes made** of concentric cylinders of graphene layers have now become available. The subtle structure parameters such as helicity in the C network and the nanometer diams. give the **nanotubes** a rich variety in phys. properties. Recent exptl. progress on the measurements of properties using EELS, Raman spectroscopy,

electron-spin resonance, elec. conductance,
mech. stiffness and theor. predictions on electronic and mech. properties of **nanotubes** are discussed. In addn. to **synthesis** techniques, methods to purify and **make** aligned arrays of **nanotubes** will be described. Different approaches for **fabricating** composite structures using **nanotubes** as molds and templates and their future implications in materials science will be evaluated. Finally, promising areas of future applications, for example as tiny field-emitting devices, micro-electrodes, nanoprobes and H storage material will be outlined.

CC 78-0 (Inorganic Chemicals and Reactions)
Section cross-reference(s): 65, 73, 75

ST review carbon **nanotube** growth structure property

IT **Nanotubes**
RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(carbon; structure and growth and properties of)

IT Crystal growth
ESR (electron spin resonance)
Electric conductivity
Electrodes
Electron energy loss spectroscopy
Molecular structure
Purification
Raman spectra
Stiffness
(of carbon **nanotubes**)

IT 7440-44-0P, Carbon, **preparation**
RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(structure and growth and properties of carbon **nanotubes**)

L30 ANSWER 13 OF 16 HCA COPYRIGHT 2003 ACS on STN

127:313991 Room temperature **electron spin resonance** of the purified carbon **nanotubes produced** in different helium pressures. Zhang, Hai-Yan; Wang, Deng-Yu; Xue, Xin-Min; He, Yan-Yang; Wu, Ming-Mei; Peng, Shao-Qi (Dep. of Math. and Phys., Guangdong Univ. of Technol., Canton, 510090, Peop. Rep. China). Chinese Physics Letters, 14(8), 625-628 (English) **1997**. CODEN: CPLEEU. ISSN: 0256-307X. Publisher: Chinese Physical Society.

AB The **ESR** of purified carbon **nanotubes prepd.** under different helium pressures from 20.0 to 80.0 kPa in arc discharge was measured. The dependence of the **ESR spin** d., linewidth and g value of the purified **nanotubes** on the helium pressure is found. The electronic properties of purified **nanotubes** varying with He pressure are discussed.

CC 77-6 (Magnetic Phenomena)

ST carbon **nanotube ESR** helium pressure

IT Controlled atmospheres
ESR (electron spin resonance)
Nanotubes
(room temp. **ESR** of the purified carbon **nanotubes produced** in different helium pressures)

IT 7440-59-7, Helium, uses
RL: MSC (Miscellaneous); TEM (Technical or engineered material use); USES (Uses)
(room temp. **ESR** of the purified carbon **nanotubes produced** in different helium pressures)

IT 7440-44-0D, Carbon, **nanotubes**, properties
RL: PRP (Properties)

(room temp. **ESR** of the purified carbon **nanotubes** **produced** in different helium pressures)

L30 ANSWER 14 OF 16 HCA COPYRIGHT 2003 ACS on STN
125:151566 Mechanical damage of carbon **nanotubes** by ultrasound. Lu, K. L.; lago, R. M.; Chen, Y. K.; Green, M. L. H.; Harris, P. J. F.; Tsang, S. C. (Inst. of Chemistry, Academia Sinica, Taipei, Taiwan). Carbon, 34(6), 814-816 (English) **1996**. CODEN: CRBNAH. ISSN: 0008-6223. Publisher: Elsevier.

AB The electron micrographs of sonicated **nanotubes** revealed a very high concn. of defects such as bending, buckling, fracture of graphene layers, and stripping of outer graphene layers. High-energy ultrasound caused more serious damage to carbon nanoparticles **producing** bundles of carbon ribbons; further sonication turned these to amorphous carbon. The extent of structural deformation in the tubes was solvent dependent; less damage was found in water or ethanol. The sonicated tube samples were studied by Raman and **ESR** spectroscopies confirming the structure findings. The oxidn. was studied of the carbon samples in stream of oxygen (0.2 g, 4% O2 in He) with heating rate of 5.degree.C/min. The onset temp. was around 600.degree.C for freshly **prepd.** **nanotubes,** higher than that of graphite (.apprx. 540.degree.C); the onset temp. decreased with sonication (20 min) to .apprx. 500.degree.C.

CC 65-5 (General Physical Chemistry)

ST damage carbon **nanotube** ultrasound Raman **ESR**; oxidn carbon **nanotube** damage ultrasound

IT Clusters
(carbon **nanotubes**; mech. damage of carbon **nanotubes** and nanoparticles by ultrasound)

IT **Electron spin resonance**
Raman spectra
Sound and Ultrasound
(mech. damage of carbon **nanotubes** and nanoparticles by ultrasound)

IT Oxidation
(mech. damage of carbon **nanotubes** and nanoparticles by ultrasound and oxidn.)

IT Particles
(nano-, carbon; mech. damage of carbon **nanotubes** and nanoparticles by ultrasound)

IT Carbon **fibers**, properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(**nanotube**, mech. damage of carbon **nanotubes** and nanoparticles by ultrasound)

IT 7440-44-0, Carbon, properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(**nanotubes**; mech. damage of carbon **nanotubes** and nanoparticles by ultrasound)

L30 ANSWER 15 OF 16 HCA COPYRIGHT 2003 ACS on STN
124:304093 Electrical, magnetic and structural characterization of fullerene soots. Dunne, L. J.; Sarkar, A. K.; Kroto, H. W.; Munn, J.; Kathirgamanathan, P.; Heinren, U.; Fernandez, J.; Hare, J.; Reid, D. G.; Clark, A. D. (School Chemistry and Molecular Sciences, Univ. Sussex, Brighton, BN1 9QJ, UK). Journal of Physics: Condensed Matter, 8(13), 2127-41 (English) **1996**. CODEN: JCOMEL. ISSN: 0953-8984. Publisher: Institute of Physics Publishing.

AB Although it is some five years since fullerenes were extd. in a

macroscopic quantities from the black, superficially amorphous sooty deposits **produced** by a C arc under He, little is known in detail about the structure of the deposit or its elec. and magnetic properties. Here the authors provide evidence that this deposit, known as fullerene soot, is composed of defective networks of C atoms which do not have all valencies satisfied. The authors have studied these soots, before and after thermal annealing, using x-ray and electron diffraction, **electron spin-resonance (ESR)** spectroscopy, IR transmission and measurements of elec. cond. Localized states assocd. with such dangling bonds are removed from the soot on annealing and this process is accompanied by an ordering transition which modifies the elec. and magnetic properties. The fullerene soot particles appear to be encapsulated aggregates of highly defective C 'onions'. Such metastable defective networks undergo a subtle ordering processes upon heat treatment which is accompanied by a rise in the elec. cond. and a loss of paramagnetism due to the elimination of unsatisfied C atom valencies. Elec. cond. and IR transmission measurements indicate that the center of these 'onions' is graphitic, with metallic properties. The temp. dependence of the elec. cond. suggests that charge transport in both annealed and unannealed materials occurs by tunneling between metallic islands in the sample. The **ESR** linewidth, arising from the **spin** centers in fullerene soots, is not significantly changed by exposure to O. Probably the free radical centers in fullerene soots are extremely efficiently isolated from the atm.-presumably by encapsulation. This behavior contrasts with that of amorphous carbons **prepd**. by thermal decompn. of org. materials (chars). The **ESR** g-factors of the fullerene soots are lower than those of chars, which suggests that the radicals in fullerene soots have strong sigma character due to unsatisfied sp2-type valencies. A plausible structure and assocd. annealing mechanism for the fullerene soot is presented based on these exptl. observations.

CC 76-11 (Electric Phenomena)
Section cross-reference(s): 65, 77

IT Annealing
Electric conductivity and conduction
Electron spin resonance
Infrared spectra
Magnetic susceptibility
Optical absorption
Order
Soot
Tunneling
g-factor
(structure and properties of fullerene soot from carbon arc under helium before and after annealing)

IT Capillary tubes and channels
(**nanotubes**, structure and properties of fullerene soot from carbon arc under helium before and after annealing)

IT 7782-44-7, Oxygen, processes
RL: NUU (Other use, unclassified); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)
(effect of oxygen exposure on **ESR** of fullerene soot)

L30 ANSWER 16 OF 16 HCA COPYRIGHT 2003 ACS on STN

124:74625 Physico-chemical studies on **nanotubes** and their encapsulated compounds. Terrones, M.; Hare, J. P.; Hsu, K.; Kroto, H. W.; Lappas, A.; Maser, W. K.; Pierik, A. J.; Prassides, K.; Taylor, R.; Walton, D. R. M. (Sch. Chem. and Mol. Sci., Univ. Sussex, Brighton, BN1 9QJ, UK). Proceedings - Electrochemical Society, 95-10(Proceedings of the Symposium on Recent Advances in the Chemistry and Physics of Fullerenes

and Related Materials, 1995), 599-620 (English) **1995**. CODEN: PESODO. ISSN: 0161-6374. Publisher: Electrochemical Society.

AB Carbon **nanotubes** promise to have important applications in material sciences, nano-engineering and nanoscale electronics. X-ray and HRTEM studies show that these tubular structures have varying morphologies and characteristics, depending on **prodn**. methods. The carrier gas pressure and current applied appear to be important factors in the arc discharge method for changing the amt. of **nanotubes**, nanoparticles, amorphous carbon, and graphitic sheets present in these structures. Variations in pressure and/or current may also influence the av. dimensions of the **nanotubes** and therefore further attempts in the direction of a controlled **prodn. of nanotubes** with specific properties have yet to be achieved. Polyhedral carbon particles and carbon **nanotubes** contg. tantalum carbide and molybdenum carbide crystals can be **generated** by inserting the resp. metals into the anode during **prodn**. in the arc-discharge expt. HRTEM images revealed that TaC carbide micro-crystals are present inside both nanoparticles and **nanotubes**, while MoC appears mainly to be present inside polyhedral particles. **ESR**, SQUID and cond. measurements indicate that the electronic and magnetic properties of these carbide crystals deposited at the cathode differ from the nonencapsulated ones. These observations promise to open up a new area of materials whose behavior is modified by microencapsulation.

CC 78-3 (Inorganic Chemicals and Reactions)
Section cross-reference(s): 76, 77

ST carbon **nanotube prepn** metal carbide encapsulation; tantalum carbide encapsulation carbon nanoparticle **nanotube**; molybdenum carbide encapsulation carbon; elec cond carbon encapsulated metal carbide

IT Electric conductivity and conduction
Electron spin resonance
Magnetic susceptibility
(carbon **nanotube** or nanoparticle encapsulated tantalum and molybdenum carbide)

IT 12011-97-1P, Molybdenum carbide (MoC) 12070-06-3P, Tantalum carbide
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)
(carbon encapsulated; **prepn**. of carbon **nanotubes** and electronic and magnetic properties of carbon encapsulated tantalum and molybdenum carbide)

IT 7440-44-0P, Carbon, **preparation**
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)
(tantalum and molybdenum carbide encapsulating; **prepn**. of carbon **nanotubes** and electronic and magnetic properties of carbon encapsulated tantalum and molybdenum carbide)

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=> file japio, wpix

FILE 'JAPIO' ENTERED AT 14:11:11 ON 19 AUG 2003

FILE 'WPIX' ENTERED AT 14:11:11 ON 19 AUG 2003

=> d L47 1-16 ti

L47 ANSWER 1 OF 16 JAPIO (C) 2003 JPO on STN
TI METHOD FOR PRODUCING CARBON **NANOTUBE**

L47 ANSWER 2 OF 16 JAPIO (C) 2003 JPO on STN
TI CARBON **NANOTUBE** THIN FILM DEPOSITION **ECR** PLASMA **CVD** SYSTEM USING SLOT ANTENNA AND METHOD FOR DEPOSITING THE SAME THIN FILM

L47 ANSWER 3 OF 16 JAPIO (C) 2003 JPO on STN
TI PLASMA ENHANCED **CVD** SYSTEM FOR LARGE-DIAMETER CARBON **NANOTUBE** THIN FILM DEPOSITION, AND METHOD OF DEPOSITION FOR THE THIN FILM

L47 ANSWER 4 OF 16 JAPIO (C) 2003 JPO on STN
TI **ECR** PLASMA ENHANCED **CVD** SYSTEM FOR CARBON **NANOTUBE** THIN FILM DEPOSITION, AND METHOD OF DEPOSITION FOR THE THIN FILM

L47 ANSWER 5 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Method of forming carbon **nanotubes** for electrochemical capacitors, involves forming **nanotube** by plasma enhanced **chemical vapor deposition** using carbon containing gas plasma.

L47 ANSWER 6 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Method of forming carbon **nanotubes** e.g. for fuel cells, involves heating coiled filament provided with substrate with catalytic coating, and pyrolyzing reactant gas to deposit carbon **nanotubes**.

L47 ANSWER 7 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Carbon **nano tube** manufacturing method involves applying **electron cyclotron resonance** plasma having carbon content on substrate maintained at preset temperature so as to form carbon **nano tube**.

L47 ANSWER 8 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI **Production** of carbon **nanotube** tip for nano-tweezers involves exposing tip assembly bearing metallic catalytic material to gaseous atmosphere comprising carbon containing gas.

L47 ANSWER 9 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Preparation of single wall carbon **nanotubes** by deposition using electronic resonance plasma(**ECR**) produced within a magnetically confined chamber.

L47 ANSWER 10 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Field emitter for integrated circuit board of electron beam lithographic stepper, includes carbon containing tip grown from bottom of dielectric well using catalyst.

L47 ANSWER 11 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI **ECR** plasma device for forming carbon **nano tube** thin film used as flat surface display, comprises slot antenna at downstream side of micro-wave generation system to introduce micro-wave into film forming chamber.

L47 ANSWER 12 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI **Fabrication** of triode-structure carbon **nanotube** field

emitter array involves forming non-reactive layer for preventing carbon **nanotubes** from growing on catalyst layer outside a micro-**cavity**.

L47 ANSWER 13 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Apparatus used for separating fluid mixture, e.g. by permeation, pervaporation, filtration, drying or sterilization or as membrane **reactor**, has porous part in contact with polymer, carbon **fiber**, metal or ceramic separating layer.

L47 ANSWER 14 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Carbon **nano tube** thin film formation apparatus for manufacture of field emission display device has microwave introductory pipe having conical trapezium shape inserted in the film forming chamber.

L47 ANSWER 15 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Thin film formation method for carbon **nano tube**, involves introducing **microwaves** into film forming **chamber** through quartz upper cover.

L47 ANSWER 16 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Plasma deposition at **cyclotron resonance**, of **web** of carbon **nanofibers** or **nanotubes** on non-catalytic substrate, forming large grid or filter structures using magnetic mirror under lower pressures.

=> d L47 1-12,14-16 all

L47 ANSWER 1 OF 16 JAPIO (C) 2003 JPO on STN
AN 2002-069643 JAPIO
TI METHOD FOR PRODUCING CARBON **NANOTUBE**
IN HOSHI FUMIYUKI; ISHIKURA TAKEFUMI; YUMURA MORIO; FUJIWARA SHUZO; KOGA YOSHINORI
PA NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL & TECHNOLOGY
TOKYO GAS CO LTD
PI JP 2002069643 A 20020308 Heisei
AI JP 2000-259692 (JP2000259692 Heisei) 20000829
PRAI JP 2000-259692 20000829
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 2002
IC ICM C23C016-26
ICS B82B003-00; C01B031-02; C23C016-511
ICA H05H001-46
AB PROBLEM TO BE SOLVED: To provide a method for efficiently producing a high quality carbon **nanotube** at a low-temperature of about 500-850°C under low pressure of 10-4-10-1 Pa without applying any electrical field.
SOLUTION: This method for producing a carbon **nanotube** comprises introducing a gaseous carbon-containing material into a plasma generating chamber in which inside pressure is held at a level of 10-4-10-1 Pa, a microwave is introduced, and further, a magnetic field is applied to the microwave, generating a electronic **cyclotron resonance** plasma of the carbon-containing material, bringing the plasma into contact with a substrate which is held at a temperature of 500-850°C, and depositing the carbon **nanotube** on the substrate in the vertical direction.
COPYRIGHT: (C)2002,JPO

L47 ANSWER 2 OF 16 JAPIO (C) 2003 JPO on STN
AN 2001-295047 JAPIO

TI CARBON **NANOTUBE** THIN FILM DEPOSITION **ECR** PLASMA
CVD SYSTEM USING SLOT ANTENNA AND METHOD FOR DEPOSITING THE SAME
THIN FILM
IN AGAWA YOSHIAKI; YAMAGUCHI KOICHI
PA ULVAC JAPAN LTD
PI JP 2001295047 A **20011026** Heisei
AI JP 2000-108319 (JP2000108319 Heisei) 20000410
PRAI JP 2000-108319 20000410
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 2001
IC ICM C23C016-26
ICS B01J019-12; C01B031-02; C23C016-511
AB PROBLEM TO BE SOLVED: To provide a carbon **nanotube** thin film deposition **ECR** plasma **CVD** system using a slot antenna which requires little labor, has high capacity of **producing** a carbon **nanotube**, low electric power consumption, and low **production** cost and to provide a method for depositing the same thin film.
SOLUTION: In an **ECR** plasma **CVD** system, at least one slot antenna is disposed on the downstream side of a **microwave** generating system, and **microwaves** are introduced from the slot antenna into a film deposition **chamber**. By using this system, mixed **ECR** plasma of a carbon-containing gas and gaseous hydrogen is generated, and a carbon **nanotube** thin film is deposited uniformly on a substrate in the direction vertical to the substrate.
COPYRIGHT: (C)2001,JPO

L47 ANSWER 3 OF 16 JAPIO (C) 2003 JPO on STN
AN 2001-192830 JAPIO
TI PLASMA ENHANCED **CVD** SYSTEM FOR LARGE-DIAMETER CARBON
NANOTUBE THIN FILM DEPOSITION, AND METHOD OF DEPOSITION FOR THE
THIN FILM
IN AGAWA YOSHIAKI; TAKAHASHI SHOJIRO; YAMAMOTO YOSHIHIRO; YAMAGUCHI KOICHI;
HIRAKAWA MASAAKI; MURAKAMI HIROHIKO
PA ULVAC JAPAN LTD
PI JP 2001192830 A 20010717 Heisei
AI JP 2000-300 (JP2000000300 Heisei) 20000105
PRAI JP 2000-300 20000105
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 2001
IC ICM C23C016-26
ICS C01B031-02; C23C016-511
AB PROBLEM TO BE SOLVED: To provide a **CVD** system for large-diameter carbon **nanotube** thin film deposition, requiring no much labor having high **production** capacity of carbon **nanotube** and low electric power consumption and reduced in manufacturing cost, and a method of deposition for the thin film.
SOLUTION: In the **CVD** system for carbon **nanotube** thin film deposition by means of **microwave** plasma enhanced **chemical vapor deposition**, a plurality of **microwave** generation systems are arranged in a row and the **cavities** of the systems are arranged right above the upper lid of the deposition **chamber**. A plurality of slits are provided to the bottoms of the **cavities** of the **microwave** generation systems and the **microwave** is passed through these slit and introduced into the deposition **chamber** via the quartz upper lid right under the **cavities**. The carbon **nanotube** thin film can be deposited by using this system.
COPYRIGHT: (C)2001,JPO

L47 ANSWER 4 OF 16 JAPIO (C) 2003 JPO on STN
AN 2001-192829 JAPIO

TI ECR PLASMA ENHANCED **CVD** SYSTEM FOR CARBON **NANOTUBE** THIN FILM DEPOSITION, AND METHOD OF DEPOSITION FOR THE THIN FILM
IN AGAWA YOSHIAKI
PA ULVAC JAPAN LTD
PI JP 2001192829 A 20010717 Heisei
AI JP 2000-299 (JP2000000299 Heisei) 20000105
PRAI JP 2000-299 20000105
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 2001
IC ICM C23C016-26
ICS C01B031-02
AB PROBLEM TO BE SOLVED: To provide a timesaving **CVD** system for carbon **nanotube** thin film deposition, requiring no much labor, having high **production** capacity of carbon **nanotube** and low electric power consumption and reduced in manufacturing cost, and a method of deposition for the thin film.
SOLUTION: In the **CVD** system for carbon **nanotube** thin film deposition by means of **microwave ECR** plasma enhanced **chemical vapor deposition**, the end part of a **microwave** introducing tube of **microwave** generation systems is provided inside a deposition **chamber**. The end part has a hornlike truncated cone shape widening toward the end, and a quarts partition member is provided to the **microwave** introducing tube, in its connecting part with the deposition **chamber** or in its vicinity. The carbon **nanotube** thin film is deposited by using this system.
COPYRIGHT: (C)2001,JPO

L47 ANSWER 5 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
AN 2003-300477 [29] WPIX
DNN N2003-239141 DNC C2003-078177
TI Method of forming carbon **nanotubes** for electrochemical capacitors, involves forming **nanotube** by plasma enhanced **chemical vapor deposition** using carbon containing gas plasma.
DC A35 E36 F06 J04 L02 L03 U11 U12 V01 V05 V06 W02
IN BOSKOVIC, B O; HAQ, S; SILVA, P S R
PA (UYSU-N) UNIV SURREY
CYC 100
PI WO 2003011755 A1 20030213 (200329)* EN 50p C01B031-02
RW: AT BE BG CH CY CZ DE DK EA EE ES FI FR GB GH GM GR IE IT KE LS LU MC MW MZ NL OA PT SD SE SK SL SZ TR TZ UG ZM ZW
W: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ OM PH PL PT RO RU SD SE SG SI SK SL TJ TM TN TR TT TZ UA UG US UZ VN YU ZA ZM ZW
ADT WO 2003011755 A1 WO 2002-GB3438 20020726
PRAI GB 2001-18341 20010727; GB 2001-18276 20010727; GB 2001-18279 20010727
IC ICM C01B031-02
AB WO2003011755 A UPAB: 20030505
NOVELTY - The carbon **nanotubes** (9) are formed by plasma enhanced **chemical vapor deposition** using a carbon containing gas plasma. The **nanotubes** are not formed on substrate with temperature of 300 deg. C or more.
DETAILED DESCRIPTION - INDEPENDENT CLAIMS are included for the following:
(1) Carbon **nanotube** comprising Y- or H-shaped junction; and
(2) Rope of carbon **nanotubes**.

USE - For electrochemical capacitors, nanoelectronics, electronic and photonic device applications, field emission devices, polymer composite **fabrication**, micro electro-mechanical systems, **microwave** resonators, structural materials and electronic semiconductor materials.

ADVANTAGE - **Nanotubes** with desired shape are obtained with high inherent strength.

DESCRIPTION OF DRAWING(S) - The figure shows illustration of a plasma **chamber** for forming and growing carbon **nanotubes**.

Vacuum **chamber** 1
Earthed electrode 6
Substrate 7
Carbon **nanotube** 9
Dwg.1/9

FS CPI EPI
FA AB; GI; DCN
MC CPI: A11-C04B2; A12-E01; E05-U02; E11-N; F03-E01; F04-E; J04-E01; L02-H04B; L03-B01; L03-D04D; L03-G05D; L04-E; N02-A01; N02-B01; N02-C01; N04-A
EPI: U11-C01J6; U11-C18B9; U12-B03D; U12-B03F1; U12-B03F2; U12-E01B2; V01-B01C; V05-F05C1A; V05-F05E5; V05-F08D1; V05-L01A3A; V06-K07A; V06-M06G; W02-A03A

L47 ANSWER 6 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
AN 2003-298656 [29] WPIX
DNN N2003-237495 DNC C2003-077710
TI Method of forming carbon **nanotubes** e.g. for fuel cells, involves heating coiled filament provided with substrate with catalytic coating, and pyrolyzing reactant gas to deposit carbon **nanotubes**.
DC E36 H06 J01 J04 L02 L03 U12 X22
IN JAYATISSA, A H
PA (JAYA-I) JAYATISSA A H
CYC 1
PI US 2002150684 A1 20021017 (200329)* 5p C23C016-00
ADT US 2002150684 A1 US 2001-835757 20010416
PRAI US 2001-835757 20010416
IC ICM C23C016-00
ICS C23C014-00
AB US2002150684 A UPAB: 20030505

NOVELTY - A coiled filament (4) provided with a substrate (7) with catalytic coating (8), is placed in a **chemical vapor deposition** (**CVD**) **chamber** (1). Air present in the **chamber** is evacuated and the filament is heated and a bias voltage is applied between the filament and substrate. A reactant gas is introduced into the **chamber** and pyrolyzed, to deposit carbon **nanotubes** on the substrate.

DETAILED DESCRIPTION - An INDEPENDENT CLAIM is included for apparatus for forming carbon **nanotubes** which has a **CVD chamber**, inlet (2) for reactant gas, substrate holder (6) and heater for pyrolyzing the reactant gas. The heater comprises a coiled filament and the holder is electrically biased to the coiled filament.

USE - For forming carbon **nanotubes** for use in fuel cells, emission devices, catalysts, filtration and purification, and sensors and microelectro-mechanical manufacturing systems technology.

ADVANTAGE - The method forms densely-packed carbon **nanotubes** by a batch process. The carbon **nanotubes** are formed in a high-density, close-packed configuration to enable large-scale **production**. The carbon **nanotubes** are densely-packed and can be easily separated from the substrate without damage.

DESCRIPTION OF DRAWING(S) - The figure shows a schematic representation of an apparatus used for forming carbon **nanotubes**

on a single substrate.
chemical vapor deposition
chamber 1
gas inlet 2
coiled filament 4
substrate holder 6
substrate 7
catalytic coating 8
Dwg.1/3
FS CPI EPI
FA AB; GI; DCN
MC CPI: E05-U02; H06-A03; J01-D01; J01-E02B; J01-E03C; J01-H; J04-C04;
J04-E04; L02-H04B; L03-E04; N02-A01; N02-B01; N02-C01; N03-D01;
N06-E01; N07-K
EPI: U12-B03F2; X22-F01

L47 ANSWER 7 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
AN 2002-503125 [54] WPIX
DNN N2002-398158 DNC C2002-142950
TI Carbon **nano tube** manufacturing method involves
applying **electron cyclotron resonance** plasma
having carbon content on substrate maintained at preset temperature so as
to form carbon **nano tube**.
DC E36 L02 M13 Q68 U11 U12 V05 X14
PA (DOKU-N) DOKURITSU GYOSEI HOJIN SANGYO GIJUTSU SO; (TOLG) TOKYO GAS CO LTD
CYC 1
PI JP 2002069643 A 20020308 (200254)* 5p C23C016-26 <--
ADT JP 2002069643 A JP 2000-259692 20000829
PRAI JP 2000-259692 20000829
IC ICM C23C016-26
ICS B82B003-00; C01B031-02; C23C016-511
ICA H05H001-46
AB JP2002069643 A UPAB: 20020823
NOVELTY - A carbon gas is introduced into a plasma chamber maintained at a
specified pressure, and magnetic field is impressed to microwave waveguide
in the chamber. The **electron cyclotron**
resonance plasma having carbon content is applied on a substrate
maintained at a temperature of 500-850 deg. C so as to form carbon
nano tube on the substrate perpendicularly.
USE - For manufacturing carbon **nano tubes**.
ADVANTAGE - Enables production of a high quality carbon **nano**
tube efficiently, without impressing an electric field.
Dwg.0/0
FS CPI EPI GMPI
FA AB; DCN
MC CPI: E05-U02; E11-N; E31-N03; L02-H04B; M13-E02; M13-E05
EPI: U11-C01J6; U11-C09C; U12-E01B2; V05-F05C3; V05-F05E5; V05-F08D1;
X14-F

L47 ANSWER 8 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
AN 2002-479549 [51] WPIX
DNN N2002-378728 DNC C2002-136414
TI **Production** of carbon **nanotube** tip for nano-tweezers
involves exposing tip assembly bearing metallic catalytic material to
gaseous atmosphere comprising carbon containing gas.
DC B04 E36 J04 S02 S03 V05
IN CHEUNG, C L; HAFNER, J H; KIM, P; LIEBER, C M
PA (HARD) HARVARD COLLEGE; (CHEU-I) CHEUNG C L; (HAFN-I) HAFNER J H; (KIMP-I)
KIM P; (LIEB-I) LIEBER C M
CYC 97

PI WO 2002026624 A1 20020404 (200251)* EN 46p C01B031-02
RW: AT BE CH CY DE DK EA ES FI FR GB GH GM GR IE IT KE LS LU MC MW MZ
NL OA PT SD SE SL SZ TR TZ UG ZW
W: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK
DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR
KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PH PL PT RO
RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG UZ VN YU ZA ZW
AU 2001094876 A 20020408 (200252) C01B031-02
US 2002122766 A1 20020905 (200260) D01F009-12
ADT WO 2002026624 A1 WO 2001-US30445 20010928; AU 2001094876 A AU 2001-94876 20010928; US 2002122766 A1 Provisional US 2000-237347P 20000929, US 2001-966812 20010928
FDT AU 2001094876 A Based on WO 200226624
PRAI US 2000-237347P 20000929; US 2001-966812 20010928
IC ICM C01B031-02; D01F009-12
ICS G12B021-08
AB WO 200226624 A UPAB: 20020812
NOVELTY - A carbon **nanotube** tip is **produced** by applying a metallic catalytic material to a tip assembly, inserting the tip assembly into a **chemical vapor deposition** (**CVD**) **reactor**, and exposing the tip assembly to a gaseous atmosphere comprising a carbon containing gas for **producing** a tip assembly bearing a carbon **nanotube** tip.

USE - The method is used in **producing** carbon **nanotube** tip for nano-tweezers (claimed) for **fabricating** quantum dot and quantum wire structures, as electromechanical sensor for detecting pressure or viscosity of media by measuring the change of resonance frequency and Q-factor of the device, as a two-tip scanning tunneling microscope (STM) or conducting atomic force microscopes (AFM) probe, or for manipulating and modifying of biological systems such as structures within a cell.

ADVANTAGE - The carbon **nanotube** tip **produced** by the invention can function as robust, high resolution probes in AFM experiments, thus the **CVD** process can be advantageously repeated at least 5-6 times without replacing the catalyst.

DESCRIPTION OF DRAWING(S) - The figure shows schematically an AFM cantilever assembly.
Dwg.1A/15
FS CPI EPI
FA AB; GI; DCN
MC CPI: B05-B02C; B05-C06; B05-U; B12-K04; E11-N; E31-N03; J04-B01; N02-A;
N02-B; N02-C; N02-E01; N02-F; N03-D02; N07-G
EPI: S02-F04; S03-E02F1; S03-E02F3; S03-E06B1; S03-F03A; V05-F01A1B

L47 ANSWER 9 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
AN 2002-417118 [44] WPIX
DNN N2002-328255 DNC C2002-117694
TI Preparation of single wall carbon **nanotubes** by deposition using electronic resonance plasma(**ECR**) produced within a magnetically confined chamber.
DC E36 L02 L03 Q68 U11 U12 V05 X14
IN DELAUNAY, M; VANNUFEL, C; VANNUFFEL, C
PA (COMS) COMMISSARIAT ENERGIE ATOMIQUE
CYC 21
PI WO 2002034669 A1 20020502 (200244)* FR 55p C01B031-02 <--
RW: AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE TR
W: JP US
FR 2815954 A1 20020503 (200244) B82B003-00 <--
ADT WO 2002034669 A1 WO 2001-FR3334 20011026; FR 2815954 A1 FR 2000-13831 20001027

PRAI FR 2000-13831 20001027
IC ICM B82B003-00; C01B031-02
ICS C01B003-00; C23C016-26; C23C016-511; C30B029-66; C30B030-02; C30B030-04; H05H001-18; H05H001-24
AB WO 200234669 A UPAB: 20020711
NOVELTY - Process for **ECR** plasma deposition of mono-walled carbon **nanotubes** on a substrate free of catalyst by injection of microwave power in a deposition chamber comprising a magnetic mirror confinement system and an **ECR** zone.
DETAILED DESCRIPTION - Process for **ECR** plasma deposition of mono-walled carbon **nanotubes** on a substrate free of catalyst by injection of microwave power in a deposition chamber comprising a magnetic mirror confinement system and an **ECR** zone. The dissociation and ionization of a gas containing carbon is initiated in the center of the chamber at a pressure of 10-3 mbar producing species which deposit on the heated substrate. The latter comprises prominence and cavities. INDEPENDENT CLAIMS are included for the apparatus and substrate.
USE - The **nanotubes** have numerous applications, in nanoelectronics, storage of hydrogen for fuel cells, electron emitters for flat screens and uses as semi-conductors.
ADVANTAGE - The invention represents a first successful preparation of single-walled **nanotubes** by **ECR** plasma processes. Contrary to former processes no catalysts is required, and deposition of **nanotubes** is possible at relatively low temperatures on large surface areas.
Dwg.1/7
FS CPI EPI GMPI
FA AB; GI; DCN
MC CPI: E05-U; E11-N; E11-P; L02-H04B; L03-H04D
EPI: U11-C01B; U12-B03F2; V05-F05C1A; V05-F05C3; V05-F05E5; V05-F08D1; X14-F01

L47 ANSWER 10 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
AN 2002-392809 [42] WPIX
DNC C2002-110436
TI Field emitter for integrated circuit board of electron beam lithographic stepper, includes carbon containing tip grown from bottom of dielectric well using catalyst.
DC L03
IN BRITTON, C L; GUILLORN, M A; LOWNDES, D H; MERKULOV, V I; SIMPSON, M L
PA (UTBA-N) UT-BATTELLE LLC; (UNAC) UT BATTELLE LLC
CYC 97
PI US 2002024279 A1 20020228 (200242)* 21p H01J001-02
WO 2002019372 A2 20020307 (200242) EN H01J029-00
RW: AT BE CH CY DE DK EA ES FI FR GB GH GM GR IE IT KE LS LU MC MW MZ NL OA PT SD SE SL SZ TR TZ UG ZW
W: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW
AU 2001083323 A 20020313 (200249) H01J029-00
EP 1314176 A2 20030528 (200336) EN H01J009-02
R: AL AT BE CH CY DE DK ES FI FR GB GR IE IT LI LT LU LV MC MK NL PT RO SE SI TR
ADT US 2002024279 A1 Provisional US 2000-228713P 20000829, US 2001-810531 20010315; WO 2002019372 A2 WO 2001-US25270 20010809; AU 2001083323 A AU 2001-83323 20010809; EP 1314176 A2 EP 2001-962116 20010809, WO 2001-US25270 20010809
FDT AU 2001083323 A Based on WO 200219372; EP 1314176 A2 Based on WO 200219372
PRAI US 2000-228713P 20000829; US 2001-810531 20010315

IC ICM H01J001-02; H01J009-02; H01J029-00
AB US2002024279 A UPAB: 20020704
NOVELTY - A field emitter has a carbon containing tip having a base located at a bottom of the dielectric well and extending away from the substrate (300). The carbon containing tip is grown from the bottom of the dielectric well using a catalyst that is introduced at the bottom of the dielectric well after the dielectric well is formed.
DETAILED DESCRIPTION - A field emitter comprises a substrate, an electrode structure, and a carbon containing tip. The electrode structure includes a dielectric layer having a dielectric well that is formed in the dielectric layer after the dielectric layer is deposited, and an extractor layer having an extractor aperture. The carbon containing tip has a base located at a bottom of the dielectric well and extending away from the substrate. It is grown from the bottom of the dielectric well using a catalyst that is introduced at the bottom of the dielectric well after the dielectric well is formed.
An INDEPENDENT CLAIM is also included for a method for making a field emitter comprising providing a substrate on a heater plate in a vacuum **chamber**, providing a carbon source gas and an etchant gas, heating the substrate with the heater plate, and **fabricating** a carbon containing tip on the substrate with the carbon source gas and the etchant gas using plasma enhanced **chemical vapor deposition**.
USE - The field emitter is used in integrated circuit board of electron beam lithographic stepper (claimed). It is also useful in flat panel displays, massively parallel digital electrostatic e-beam array lithography, and/or electron microscopy.
ADVANTAGE - The invention provides field emitters that do not need to be lithography defined, are non-metallic, have a high aspect ratio and a high geometrical enhancement factor, a low threshold field strength, and are relatively easy to **fabricate**. It improves quality and/or reduces costs.
DESCRIPTION OF DRAWING(S) - The figure is a schematic view of an electrode-emitter.
Substrate 300
Multiwall **nanotube** 360
Dwg.3G/13
FS CPI
FA AB; GI
MC CPI: L03-G05D

L47 ANSWER 11 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
AN 2002-309150 [35] WPIX
DNN N2002-242039 DNC C2002-089986
TI **ECR** plasma device for forming carbon **nano tube** thin film used as flat surface display, comprises slot antenna at downstream side of micro-wave generation system to introduce micro-wave into film forming chamber.
DC E36 L03 M13 U11 V05 W02
PA (ULVA) ULVAC CORP
CYC 1
PI JP 2001295047 A 20011026 (200235)* 6p C23C016-26 <--
ADT JP 2001295047 A JP 2000-108319 20000410
PRAI JP 2000-108319 20000410
IC ICM C23C016-26
ICS B01J019-12; C01B031-02; C23C016-511
AB JP2001295047 A UPAB: 20020603
NOVELTY - The device comprises a film forming chamber (21), a substrate holder (24) provided inside the chamber, and a gas supply system to supply carbon containing gas and hydrogen gas to chamber. A bias power supply

(27) is connected to substrate holder. A micro-wave generation system (22) generates and introduces micro-wave into chamber via slot antenna (22f) provided to its downstream side, to produce **ECR** plasma.
DETAILED DESCRIPTION - An INDEPENDENT CLAIM is also included for formation method of carbon **nano tube** thin film.
USE - For forming carbon **nano tube** thin film used as flat surface display on components that needs an electronic light-emitting element, or used as alternative for electron tube of cathode ray tube (CRT).
ADVANTAGE - The carbon **nano tube** thin film can be formed uniformly and economically without taking much time and effort. Production capacity of the film is high. Consumption of electric power is low.
DESCRIPTION OF DRAWING(S) - The figure shows the top-elevation, side, right-side and sectional views of **electron-cyclotron-resonance** (**ECR**) plasma chemical vapor deposition (CVD) device.
Film forming chamber 21
Micro-wave generation system 22
Slot antenna 22f
Substrate holder 24
Bias power supply 27
Dwg.2/2
FS CPI EPI
FA AB; GI; DCN
MC CPI: E05-U; E05-U02; L03-H04D; M13-E05
EPI: U11-C01J6; U11-C09C; V05-F04L; V05-F05C1A; V05-F05C3; V05-F05E3; W02-B02C

L47 ANSWER 12 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
AN 2002-197219 [26] WPIX
DNN N2002-149788 DNC C2002-061139
TI **Fabrication** of triode-structure carbon **nanotube** field emitter array involves forming non-reactive layer for preventing carbon **nanotubes** from growing on catalyst layer outside a micro-**cavity**.
DC L03 U11 U12 V05
IN CHOI, Y; KIM, J; LEE, H; LEE, N; CHOI, Y S; KIM, J M; LEE, H U; LEE, N S
PA (SMSU) SAMSUNG SDI CO LTD; (SMSU) SAMSUNG DENKAN KK; (CHOI-I) CHOI Y; (KIMJ-I) KIM J; (LEEH-I) LEE H; (LEEN-I) LEE N
CYC 29
PI EP 1115135 A1 20010711 (200226)* EN 15p H01J009-02
R: AL AT BE CH CY DE DK ES FI FR GB GR IE IT LI LT LU LV MC MK NL PT RO SE SI TR
JP 2001236879 A 20010831 (200226) 9p H01J009-02
KR 2001068652 A 20010723 (200226) H01J009-02
US 6339281 B2 20020115 (200226) H01J001-304
US 2001007783 A1 20010712 (200226) H01L021-00
ADT EP 1115135 A1 EP 2001-300082 20010105; JP 2001236879 A JP 2001-1103 20010109; KR 2001068652 A KR 2000-668 20000107; US 6339281 B2 US 2001-754148 20010105; US 2001007783 A1 US 2001-754148 20010105
PRAI KR 2000-668 20000107
IC ICM H01J001-304; H01J009-02; H01L021-00
ICS C01B031-02; C23C014-06; H01L021-84
AB EP 1115135 A UPAB: 20020424
NOVELTY - A triode-structure **nanotube** field emitter array is **fabricated** by forming a separation layer; forming a catalyst layer on the separation layer and the cathode electrode within the micro-**cavity**; forming a non-reactive layer for preventing carbon **nanotubes** from growing on the catalyst layer outside the micro-

cavity; and growing carbon **nanotubes** on the catalyst layer within the micro-**cavity**.

DETAILED DESCRIPTION - **Fabrication** of triode-structure carbon **nanotube** field emitter array involves

(a) forming a separation layer on a gate electrode using slant deposition in a structure with a cathode electrode and microcavity;

(b) forming a catalyst layer (9) on the separation layer and the cathode electrode within the micro-**cavity**;

(c) performing slant deposition on the catalyst layer to form a non-reactive layer (77) for preventing carbon **nanotubes** (10) from growing on the catalyst layer outside the micro-**cavity**;

(d) growing carbon **nanotubes** on the catalyst layer within the micro-**cavity**; and removing the separation layer.

The structure also includes a gate insulation layer, and gate electrode sequentially formed on a cathode glass substrate, and a gate opening formed on the gate electrode. The cathode electrode is formed on a cathode glass substrate. The micro-**cavity**, which corresponds to the gate opening, is formed in the gate insulation layer.

USE - For **fabricating** triode field emitter array.

ADVANTAGE - The **fabrication** yield is increased, and the **fabrication** cost is decreased.

DESCRIPTION OF DRAWING(S) - The figure shows a sectional view of forming **nanotubes** on the catalyst layer.

Catalyst layer 9

Carbon **nanotubes** 10

Non-reactive layer 77

Dwg.3B/9

FS CPI EPI

FA AB; GI

MC CPI: L03-C02A; L03-G05

EPI: U11-C01J6; U11-C18B2; U12-D01B2; U12-E01B2; U12-Q; V05-L01A3A; V05-L05B5

L47 ANSWER 14 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN

AN 2001-641626 [74] WPIX

DNN N2001-479877 DNC C2001-189937

TI Carbon **nano tube** thin film formation apparatus for manufacture of field emission display device has microwave introductory pipe having conical trapezium shape inserted in the film forming chamber.

DC E36 L03 V05 X14

PA (ULVA) ULVAC CORP

CYC 1

PI JP 2001192829 A 20010717 (200174)* 6p C23C016-26 <--

ADT JP 2001192829 A JP 2000-299 20000105

PRAI JP 2000-299 20000105

IC ICM C23C016-26

ICS C01B031-02

AB JP2001192829 A UPAB: 20011217

NOVELTY - Electric power supply (27) is connected to a substrate holder (24) inside film forming chamber (21). Gas cylinders (36a,36b) supply gas containing carbon and hydrogen gas inside the chamber. Microwave generation system (22) generates **ECR** plasma inside the chamber. Microwave generation system has microwave introductory pipe (22g) having leading end having conical trapezium shape inserted in the chamber.

DETAILED DESCRIPTION - An INDEPENDENT CLAIM is also included for a thin film formation method.

USE - For manufacture of field emission display device.

ADVANTAGE - Enables to form thin film uniformly on the substrate without much time and effort, improves production capacity of carbon **nano tube** and reduces power consumption and

manufacturing cost.
DESCRIPTION OF DRAWING(S) - The figure shows the block diagram of carbon **nano tube** thin film formation apparatus.
(Drawing includes non-English language text).
Inside film forming chamber 21
Microwave generation system 22
Microwave introductory pipe 22g
Substrate holder 24
Electric power supply 27
Gas cylinders 36a,36b
Dwg.2/2
FS CPI EPI
FA AB; GI; DCN
MC CPI: E05-U; L03-C02
EPI: V05-F05C1A; V05-F05C3; V05-F08D1; V05-L01A3A; V05-L05A1; X14-F

L47 ANSWER 15 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
AN 2001-629274 [73] WPIX
DNN N2001-469294 DNC C2001-187682
TI Thin film formation method for carbon **nano tube**, involves introducing **microwaves** into film forming **chamber** through quartz upper cover.
DC E36 L03 V05 X14
PA (ULVA) ULVAC CORP
CYC 1
PI JP 2001192830 A 20010717 (200173)* 6p C23C016-26
ADT JP 2001192830 A JP 2000-300 20000105
PRAI JP 2000-300 20000105
IC ICM C23C016-26
ICS C01B031-02; C23C016-511
AB JP2001192830 A UPAB: 20011211
NOVELTY - Two **microwave** generators (22,22') are arranged oppositely with **cavities** (22f) of each generator provided with slits (38). The **cavity** of each generator is arranged over an upper cover (23) made of quartz. **Microwaves** are guided along the slits and are introduced into film forming **chamber** through the upper cover.
DETAILED DESCRIPTION - An INDEPENDENT CLAIM is also included for thin film forming apparatus.
USE - For forming thin film for carbon **nano tube** used in flat emission displays.
ADVANTAGE - The carbon **nano tube** is manufactured in short time with less cost due to less electric power consumption, hence **productivity** is high.
DESCRIPTION OF DRAWING(S) - The figure shows the sectional view of thin film formation plasma **CVD** apparatus. (Drawing includes non-English language text).
Microwave generators 22,22'
Cavities 22f
Upper cover 23
Slits 38
Dwg.2/2
FS CPI EPI
FA AB; GI; DCN
MC CPI: E05-U02; L04-D01
EPI: V05-F04L; V05-F05C1A; V05-F08D1; V05-L01A3; V05-L01A3A; V05-L05D1; X14-F

L47 ANSWER 16 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
AN 2001-161377 [17] WPIX

DNN N2001-117681 DNC C2001-048304
TI Plasma deposition at **cyclotron resonance**, of
web of carbon **nanofibers** or **nanotubes** on
non-catalytic substrate, forming large grid or filter structures using
magnetic mirror under lower pressures.
DC L02 L03 Q68 U11 U12 V05 X14
IN DELAUNAY, M; SEMERIA, M N; SEMERIA, M
PA (COMS) COMMISSARIAT ENERGIE ATOMIQUE
CYC 27
PI FR 2795906 A1 20010105 (200117)* 45p H05H001-46 <--
WO 2001003158 A1 20010111 (200117) FR H01J037-32 <--
RW: AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE
W: JP US
EP 1192637 A1 20020403 (200230) FR H01J037-32 <--
R: AL AT BE CH CY DE DK ES FI FR GB GR IE IT LI LT LU LV MC MK NL PT
RO SE SI
JP 2003504512 W 20030204 (200320) 35p C23C016-26 <--
ADT FR 2795906 A1 FR 1999-8473 19990701; WO 2001003158 A1 WO 2000-FR1827
20000629; EP 1192637 A1 EP 2000-949577 20000629, WO 2000-FR1827 20000629;
JP 2003504512 W WO 2000-FR1827 20000629, JP 2001-508475 20000629
FDT EP 1192637 A1 Based on WO 200103158; JP 2003504512 W Based on WO 200103158
PRAI FR 1999-8473 19990701
IC ICM C23C016-26; H01J037-32; H05H001-46
ICS B82B003-00; C01B031-02; H01J009-12; H01J029-02; H01J031-12
AB FR 2795906 A UPAB: 20010328

NOVELTY - **Microwave** power is applied in deposition **chamber**. The **chamber** includes a highly de-stabilized magnetic mirror structure and at least one zone of **electron cyclotron resonance** facing the substrate. At a pressure less than 10-4 mbar, ionization and/or dissociation of a gas containing carbon is caused in the magnetic mirror at the center of the deposition **chamber**, to **produce** species for deposition onto the surface, which is heated.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are included for equipment **producing** the deposit, the layer so **produced**, a non-catalytic spidery **cloth**, a corresponding multilayer filter, optionally with substrate, a filter where the layer(s) are spread onto a rigid grid, an electron acceleration nanogrid and a flat screen of large dimensions, including the grid.

USE - To **produce** a **web** of carbon **nanofibers** or **nanotubes** on non-catalytic substrate

ADVANTAGE - The process deposits over very large areas, e.g. 1 m2. Plasma is confined by the magnetic structure. The **cyclotron** electronic **resonance** (CER) zone is located actually inside the deposition **chamber**, contrasting with prior art; there is no separation between reaction **chamber** and the deposition **chamber**. Operation is at particularly low pressure, generally below 10-4. These conditions strongly dissociate organic molecules (e.g. methane is cited) to obtain layers forming the **nanofiber** or **nanotube webs** or interconnected networks in the spidery **cloth** structure. The plasma itself remains stationery and stable. The process falls between the two extremes of physical vapor phase **deposition** (PVD) and **chemical vapor** phase **deposition** (CVD). Decomposition equations for methane, under **chamber** conditions are provided. Further discussion and quantification of conditions is included, including details of the magnetic field strengths and configurations. Practical examples are provided. Twenty references are complemented by a tabulation of prior art experimental conditions, some relating to diamond structures.
Dwg.0/5

```
FS   CPI EPI GMPI
FA   AB
MC   CPI: L02-H04A; L03-H04D
     EPI: U11-C09C; U12-B03X; V05-F05C1A; V05-F05C3; V05-F08D1; X14-F


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=> d L62 1-12 all

L62  ANSWER 1 OF 12  COMPENDEX  COPYRIGHT 2003 EEI on STN
AN   1999(17):2981  COMPENDEX
TI   Synthesis of carbon nanotubes by arc discharge in CF4
     gas atmosphere.
AU   Yokomichi, Haruo (Toyama Prefectural Univ, Toyama, Jpn); Matoba, Masaaki;
     Sakima, Hiroyuki; Ichihara, Masaki; Sakai, Fumiko
SO   Japanese Journal of Applied Physics, Part 1: Regular Papers & Short Notes
     & Review Papers v 37 n 12A Dec 1998.p 6492-6496
     CODEN: JAPNDE
PY   1998
DT   Journal
TC   Experimental
LA   English
AB   Carbon nanotubes were synthesized by arc discharge in
     a CF4 gas atmosphere involving fluorine atoms, which are able to terminate
     carbon bonding, while no fullerenes were synthesized in a CF4
     gas atmosphere.The morphology of these nanotubes was
     investigated by scanning electron microscopy (SEM) and transmission
     electron microscopy (TEM).Based on these results, the synthesized
     conditions in CF4 gas were compared with those in other gases, i.e., in
     CH4, H2, He and Ar gases.In addition, electron spin
     resonance (ESR) measurements were performed in order to obtain
     information about the electronic properties of these nanotubes.
     (Author abstract) 19 Refs.
CC   933.1 Crystalline Solids; 804 Chemical Products Generally; 802.2 Chemical
     Reactions; 804.1 Organic Components; 701.1 Electricity: Basic Concepts and
     Phenomena; 801.4 Physical Chemistry
CT   *Nanotubes; Scanning electron microscopy; Fluorine compounds;
     Electric discharges; Chemical bonds; Morphology; Electronic properties;
     Transmission electron microscopy; Fullerenes; Synthesis
     (chemical)
ST   Carbon tetrafluoride
ET   C*F; CF4; C cp; cp; F cp; C*H; CH4; H cp; H2; He; Ar
```

L62 ANSWER 2 OF 12 COMPENDEX COPYRIGHT 2003 EEI on STN
AN 1999(4):4460 COMPENDEX
TI ESR of purified carbon **nanotubes produced** under different helium pressures.
AU Wong, S.P. (Chinese Univ of Hong Kong, Hong Kong); Zhang, Haiyan; Ke, Ning; Peng, Shaoqi
MT Proceedings of the 1997 MRS Fall Symposium.
MO MRS
ML Boston, MA, USA
MD 02 Dec 1997-04 Dec 1997
SO Recent Advances in Catalytic Materials Materials Research Society Symposium - Proceedings v 497 1998.MRS, Warrendale, PA, USA.p 151-156
CODEN: MRSPDH ISSN: 0272-9172
PY **1998**
MN 48274
DT Conference Article
TC Experimental
LA English
AB Carbon **nanotubes** were prepared by the dc arc-discharge method under a controlled helium pressure ranging from 10 to 80 kPa and subsequently purified by oxidation in air. The purified carbon **nanotubes** were observed by transmission electron microscopy.The room temperature **electron spin resonance** (ESR) spectra of the purified **nanotubes** were measured. The variations in the ESR line shape, g-value, linewidth and relative **spin** density of the purified **nanotubes** on helium pressure were studied and discussed.(Author abstract) 14 Refs.
CC 804 Chemical Products Generally; 933.1 Crystalline Solids; 801.4 Physical Chemistry; 802.2 Chemical Reactions
CT *Carbon; Pressure effects; Helium; **Electron spin resonance** spectroscopy; Oxidation; Transmission electron microscopy; Purification; **Nanotubes**
ST Helium pressure; Arc discharge method

L62 ANSWER 3 OF 12 INSPEC (C) 2003 IEE on STN
AN 2000:6583274 INSPEC DN A2000-12-6148-001
TI Physical properties of carbon **nanotubes**.
AU Salvetat, J.-P.; Bonard, J.-M.; Bacsa, R.; Stockli, T.; Forro, L. (Dept. of Phys., Swiss Fed. Inst. of Technol., Lausanne, Switzerland)
SO AIP Conference Proceedings **(1998)** no.442, p.467-80. 25 refs.
Published by: AIP
Price: CCCC 0094-243X/98/$15.00
CODEN: APCPCS ISSN: 0094-243X
SICI: 0094-243X(1998)442L.467:PPCN;1-M
Conference: Electronic Properties of Novel Materials - Progress in Molecular Nanostructures. XI International Wintershcool. Kirchberg Tyrol, Austria, March 1998
DT Conference Article; Journal
TC Experimental
CY United States
LA English
AB Carbon **nanotube** science is a new exciting subject for all the carbon community. We now have in hand 1D graphite prototypes opening a new field for basic research and increasing the technological potential of traditional carbon **fibers**. In addition to many open fundamental questions, one of the main difficulties resides on the technological side, since large scale **synthesis**, high purity samples, and manipulation at the nanoscale are not yet fully developed. In this paper, we present recent development on different **nanotube** aspects:

preparation and purification, electronic transport properties,
electron spin resonance, mechanical behaviour
of individual **nanotubes**, and field-emission.

CC A6148 Structure of fullerenes and fullerene-related materials; A7125X Electronic structure of fullerenes and fullerene-related materials; intercalation compounds; A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A7630 Electron paramagnetic resonance and relaxation (condensed matter); A7970 Field emission and field ionization

CT CARBON **NANOTUBES**; ELECTRON FIELD EMISSION; MATERIALS PREPARATION; PARAMAGNETIC RESONANCE

ST **carbon nanotubes**; 1D graphite prototypes; **large scale synthesis**; high purity samples; electronic transport properties; **electron spin resonance**; mechanical behaviour; field-emission; C

CHI C el

ET D; C

L62 ANSWER 4 OF 12 INSPEC (C) 2003 IEE on STN

AN 1999:6205828 INSPEC DN A1999-09-8120V-001

TI Morphology and electronic properties of carbon **nanotubes synthesized** by arc discharge in CF4 gas.

AU Yokomichi, H.; Sakima, H.; Matoba, R. (Dept. of Electron. & Inf. Eng., Toyama Prefectural Univ., Japan); Ichihara, M.; Sakai, F.

SO Superlattices and Microstructures **(1999)** vol.25, no.1-2, p.487-91. 12 refs.
Published by: Academic Press
Price: CCCC 0749-6036/99/010487+05$30.00/0
CODEN: SUMIEK ISSN: 0749-6036
SICI: 0749-6036(1999)25:1/2L.487:MEPC;1-S
Conference: 11th International Conference on Superlattices, Microstructures and Microdevices, 1998. Hurgada, Egypt, 27-31 July 1998

DT Conference Article; Journal

TC Experimental

CY United Kingdom

LA English

AB The morphology of carbon **nanotubes synthesized** by arc discharge in a CF4 gas atmosphere was investigated by scanning electron microscopy and transmission electron microscopy. The electronic properties of these **nanotubes** were investigated by **electron spin resonance**. The **synthesis** conditions in CF4 gas were then compared with those in CH4, H2 and He based on these results. Furthermore, the mechanism of tube growth in CF4 gas was discussed briefly.

CC A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A6148 Structure of fullerenes and fullerene-related materials; A7125X Electronic structure of fullerenes and fullerene-related materials; intercalation compounds; A6150J Crystal morphology and orientation; A5275R Plasma applications in manufacturing and materials processing; A7630L EPR of other ions and impurities

CT BAND STRUCTURE; CARBON **NANOTUBES**; CRYSTAL MORPHOLOGY; PARAMAGNETIC RESONANCE; PLASMA DEPOSITION; SCANNING ELECTRON MICROSCOPY; TRANSMISSION ELECTRON MICROSCOPY

ST morphology; electronic properties; **carbon nanotubes**; arc discharge; CF4 gas; scanning electron microscopy; transmission electron microscopy; **electron spin resonance**; **synthesis conditions**; tube growth; C

CHI C el

ET C*F; CF4; C cp; cp; F cp; C*H; CH4; H cp; H2; He; C

L62 ANSWER 5 OF 12 INSPEC (C) 2003 IEE on STN

AN 1999:6137355 INSPEC DN A1999-04-8120V-003
TI **Synthesis** of carbon **nanotubes** by arc discharge in CF4
gas atmosphere.
AU Yokomichi, H.; Matoba, M.; Sakima, H.; Ichihara, M.; Sakai, F. (Dept. of
Electron. & Inf., Toyama Univ., Japan)
SO Japanese Journal of Applied Physics, Part 1 (Regular Papers, Short Notes &
Review Papers) **(Dec. 1998)** vol.37, no.12A, p.6492-6. 19 refs.
Published by: Publication Office, Japanese Journal Appl. Phys
CODEN: JAPNDE ISSN: 0021-4922
SICI: 0021-4922(199812)37:12AL.6492:SCND;1-Z
DT Journal
TC Experimental
CY Japan
LA English
AB Carbon **nanotubes** were **synthesized** by arc discharge in
a CF4 gas atmosphere involving fluorine atoms, which are able to terminate
carbon bonding, while no fullerenes were **synthesized** in a CF4
gas atmosphere. The morphology of these **nanotubes** was
investigated by scanning electron microscopy (SEM) and transmission
electron microscopy (TEM). Based on these results, the **synthesized**
conditions in CF4 gas were compared with those in other gases, i.e., in
CH4, H2, He and Ar gases. In addition, **electron spin**
resonance (ESR) measurements were performed in order to obtain
information about the electronic properties of these **nanotubes**.
CC A8120V Preparation of fullerenes and fullerene-related materials,
intercalation compounds, and diamond; A6148 Structure of fullerenes and
fullerene-related materials; A7125X Electronic structure of fullerenes and
fullerene-related materials; intercalation compounds; A7630L EPR of other
ions and impurities
CT BONDS (CHEMICAL); CARBON **NANOTUBES**; CRYSTAL MORPHOLOGY;
PARAMAGNETIC RESONANCE; PLASMA DEPOSITION; SCANNING ELECTRON MICROSCOPY;
TRANSMISSION ELECTRON MICROSCOPY
ST **synthesis; carbon nanotubes**; arc discharge; CF4 gas
atmosphere; fluorine atoms; carbon bonding; morphology; scanning electron
microscopy; SEM; transmission electron microscopy; TEM; H2; He; Ar;
electron spin resonance; ESR; electronic properties; C
CHI C el; H2 el, H el; He el; Ar el
ET C*F; CF4; C cp; cp; F cp; C*H; CH4; H cp; H2; He; Ar; C; H

L62 ANSWER 6 OF 12 INSPEC (C) 2003 IEE on STN
AN 1999:6129576 INSPEC DN A1999-04-8120V-001
TI Well-aligned carbon nitride **nanotubes** synthesized in anodic
alumina by **electron cyclotron resonance**
chemical vapor deposition.
AU Sung, S.L.; Tsai, S.L.; Tseng, C.H.; Chiang, F.K.; Liu, X.W.; Shih, H.C.
(Dept. of Mater. Sci. & Eng., Nat. Tsing Hua Univ., Hsinchu, Taiwan)
SO Applied Physics Letters **(11 Jan. 1999)** vol.74, no.2, p.197-9. 31
refs.
Doc. No.: S0003-6951(99)03102-2
Published by: AIP
Price: CCCC 0003-6951/99/74(2)/197(3)/$15.00
CODEN: APPLAB ISSN: 0003-6951
SICI: 0003-6951(19990111)74:2L.197:WACN;1-B
DT Journal
TC Experimental
CY United States
LA English
AB Vertically aligned carbon nitride **nanotubes** with a uniform
diameter of about 250 nm have been synthesized on a porous alumina
membrane template (50-80 mu m thick) in a microwave excited plasma of C2H2

and N2 using an **electron cyclotron resonance**
chemical vapor deposition system. A negative
dc bias voltage was applied to the substrate holder of graphite to promote
the flow of ionic fluxes through the nanochannels of the alumina template.
This allowed the physical, and subsequent chemical, absorption of species
on the walls of the nanochannels that resulted in the formation of the
carbon nitride **nanotubes**. The hollow structure and vertically
aligned properties of the **nanotubes** have been clearly verified
by field-emission scanning electron microscope images. The absorption band
between 1250 and 1750 cm-1 in the Fourier transform infrared spectroscopy
spectrum proves that nitrogen atoms have been incorporated into an
amorphous network of carbon.

CC A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A6148 Structure of fullerenes and fullerene-related materials; A7865V Optical properties of fullerenes and related materials (thin films/low-dimensional structures); A5275R Plasma applications in manufacturing and materials processing; A8115H Chemical vapour deposition; A7830L Infrared and Raman spectra in disordered solids

CT ALUMINA; ANODISED LAYERS; CARBON COMPOUNDS; CARBON **NANOTUBES**; FIELD EMISSION ELECTRON MICROSCOPY; FOURIER TRANSFORM SPECTRA; INFRARED SPECTRA; PLASMA **CVD**; POROUS MATERIALS; SCANNING ELECTRON MICROSCOPY

ST **C-N nanotube synthesis**; anodic Al2O3; **ECR CVD**; **electron cyclotron resonance chemical vapor deposition**; **vertically aligned carbon nitride nanotubes**; porous alumina membrane template; microwave excited plasma; C2H2- N2 plasma; negative dc bias voltage; ionic flux flow; alumina template nanochannels; chemical species absorption; hollow structure; field-emission scanning electron microscope images; Fourier transform infrared spectroscopy spectrum; amorphous C network; acetylene; 250 nm; 1250 to 1750 cm-1; C-N; Al2O3; N2

CHI CN bin, C bin, N bin; Al2O3 sur, Al2 sur, Al sur, O3 sur, O sur, Al2O3 bin, Al2 bin, Al bin, O3 bin, O bin; N2 el, N el

PHP size 2.5E-07 m; wavelength 5.71E-06 to 8.00E-06 m

ET C*H; C2H2; C cp; cp; H cp; N2; C*N; C-N; Al*O; Al2O3; Al cp; O cp; C; CN; N cp; Al2O; Al; O; N

L62 ANSWER 7 OF 12 INSPEC (C) 2003 FIZ KARLSRUHE on STN

AN 1998:5964395 INSPEC DN A9816-6146-013

TI Are boron-doped carbon **nanotubes** metallic?.

AU Yokomichi, H.; Matoba, M. (Dept. of Electron. & Inf., Toyama Prefectural Univ., Kosugi, Japan); Fukuhara, T.; Sakima, H.; Sakai, F.; Maezawa, K.

SO Physica Status Solidi B **(1 May 1998)** vol.207, no.1, p.R1-2. 4 refs.
Published by: Akademie Verlag
Price: CCCC 0370-1972/98/$17.50+0.50
CODEN: PSSBBD ISSN: 0370-1972
SICI: 0370-1972(19980501)207:1L.r1:BDCN;1-W

DT Journal

TC Experimental

CY Germany, Federal Republic of

LA English

AB Although boron-doped (B-doped) carbon **nanotubes** and boroncarbonnitrogen (B-C-N) **nanotubes** have been **synthesized**, there are not known investigations of the electronic properties of these **nanotubes**. In this brief report, we investigate the electronic properties of B-doped carbon **nanotubes** using **electron spin resonance** (ESR) and conductance measurements. The morphology of **synthesized** **nanotubes** is also investigated by scanning electron microscopy (SEM) and transmission electron microscopy (TEM).

CC A6146 Solid clusters (including fullerenes) and nanoparticles; A6480G Microstructure; A6820 Solid surface structure; A7630P EPR of conduction electrons
CT BORON; CARBON; CESR; ELECTRICAL CONDUCTIVITY; NANOSTRUCTURED MATERIALS; NITROGEN; SCANNING ELECTRON MICROSCOPY; SURFACE TOPOGRAPHY; TRANSMISSION ELECTRON MICROSCOPY
ST **carbon nanotubes**; boron doping; **boron-carbon-nitrogen nanotubes**; electronic properties; **electron spin resonance**; CESR; conductance measurements; morphology; SEM; scanning electron microscopy; TEM; transmission electron microscopy; 77 to 290 K; C:B; BCN
CHI C:B bin, B bin, C bin, B el, C el, B dop; BCN ss, CN ss, B ss, C ss, N ss
PHP temperature 7.7E+01 to 2.9E+02 K
ET B; C*B*N; B-C-N; C*B; C:B; B doping; doped materials; C*N; CN; C cp; cp; N cp

L62 ANSWER 8 OF 12 INSPEC (C) 2003 IEE on STN
AN 1997:5785389 INSPEC DN A9803-7630P-001
TI **Electron-spin resonance** and **microwave** resistivity of single-wall carbon **nanotubes**.
AU Petit, P.; Jouguelet, E. (Inst. Charles Sadron, Strasbourg, France); Fischer, J.E.; Rinzler, A.G.; Smalley, R.E.
SO Physical Review B (Condensed Matter) **(15 Oct. 1997)** vol.56, no.15, p.9275-8. 25 refs.
Doc. No.: S0163-1829(97)08440-3
Published by: APS through AIP
Price: CCCC 0163-1829/97/56(15)/9275(4)/$10.00
CODEN: PRBMDO ISSN: 0163-1829
SICI: 0163-1829(19971015)56:15L.9275:ESRM;1-0
DT Journal
TC Experimental
CY United States
LA English
AB We compare the thermal variations of ESR, dc and **microwave** resistivity of unoriented bulk single wall carbon **nanotube** samples. We conclude that the "metallic" high-T behavior (d rho /dT>0) is an intrinsic property of the bulk material, and that the system remains metallic even at low temperature where d rho ldT<0. The **spin** susceptibility is also independent of T, and a long mean free path implies transport predominantly along the tube axes in bulk material.
CC A7630P EPR of conduction electrons; A6146 Solid clusters (including fullerenes) and nanoparticles; A7325 Surface conductivity and carrier phenomena
CT CARBON; ELECTRICAL RESISTIVITY; **MICROWAVE** MEASUREMENT; NANOSTRUCTURED MATERIALS; PARAMAGNETIC RESONANCE; SURFACE CONDUCTIVITY
ST **electron-spin resonance; microwave resistivity; single-wall C nanotubes**; thermal variations; **spin susceptibility**; C
CHI C sur, C el
ET T; C

L62 ANSWER 9 OF 12 INSPEC (C) 2003 IEE on STN
AN 1997:5784594 INSPEC DN A9803-6146-003
TI Experimental verification of the dominant influence of extended carbon networks on the structural, electrical and magnetic properties of a common soot.
AU Dunne, L.J.; Nolan, P.F. (Chem. Eng. Res. Centre, South Bank Univ., London, UK); Munn, J.; Terrones, M.; Jones, T.; Kathirgamanathan, P.; Fernandez, J.; Hudson, A.D.
SO Journal of Physics: Condensed Matter **(1 Dec. 1997)** vol.9, no.48, p.10661-73. 30 refs.

Doc. No.: S0953-8984(97)85512-9
Published by: IOP Publishing
Price: CCCC 0953-8984/97/4810661+13$19.50
CODEN: JCOMEL ISSN: 0953-8984
SICI: 0953-8984(19971201)9:48L.10661:EVDI;1-H
DT Journal
TC Experimental
CY United Kingdom
LA English
AB Common soots are disordered carbonaceous materials containing several per cent of heteroatoms. A question of some importance is to what extent pure carbon networks dominate the properties of common soots. The authors report the results of a comparative study of fullerene soots which are a form of pure partially ordered carbon and those formed from flaming polystyrene combustion which contain a few per cent of oxygen atoms, using electron diffraction, **electron spin resonance** (ESR), infra-red transmission and measurements of electrical conductivity. It has been found that despite some important characteristic differences, the annealed fullerene soot and flaming polystyrene soot have a number of important structural, electrical and magnetic features in common, provided that the flame and annealing temperatures are the same. This suggests that the graphitic layer and **fullerene** related **tubular** structures found in these materials dominate the electrical properties of these soots regardless of the presence of small quantities of heteroatoms in the soot derived from the flaming combustion of polystyrene.
CC A6146 Solid clusters (including fullerenes) and nanoparticles; A7630 Electron paramagnetic resonance and relaxation; A8240P Flames, combustion, and explosions; A7830 Infrared and Raman spectra and scattering (condensed matter); A7290 Other topics in electronic transport in condensed matter
CT ANNEALING; COMBUSTION **SYNTHESIS**; ELECTRICAL CONDUCTIVITY; ELECTRON DIFFRACTION; FLAMES; FULLERENES; INFRARED SPECTRA; PARAMAGNETIC RESONANCE
ST extended C network effect; structural properties; electrical properties; magnetic properties; common soot; disordered carbonaceous materials; heteroatoms; fullerene soots; pure partially ordered C; flaming polystyrene combustion; electron diffraction; **electron spin resonance**; IR transmission; electrical conductivity; annealed fullerene soot; flaming polystyrene soot; graphitic layer; **fullerene related tubular structures**; C
CHI C el; C ss
ET C

L62 ANSWER 10 OF 12 INSPEC (C) 2003 IEE on STN
AN 1997:5743815 INSPEC DN A9724-6146-011
TI Nanometre-size tubes of carbon.
AU Ajayan, P.M. (Dept. of Mater. Sci. & Eng., Rensselaer Polytech. Inst., Troy, NY, USA); Ebbesen, T.W.
SO Reports on Progress in Physics **(Oct. 1997)** vol.60, no.10, p.1025-62. 129 refs.
Doc. No.: S0034-4885(97)65225-2
Published by: IOP Publishing
Price: CCCC 0034-4885/97/101025+38$59.50
CODEN: RPPHAG ISSN: 0034-4885
SICI: 0034-4885(199710)60:10L.1025:NSTC;1-A
DT Journal
TC General Review
CY United Kingdom
LA English
AB We review the present state of understanding of the structure, growth and properties of nanometre-size tubes of carbon. Two different types of

carbon **nanotubes**, namely single-shell **nanotubes** made
of single layers of graphene cylinders and multishell **nanotubes**
made of concentric cylinders of graphene layers have now become available.
The subtle structure parameters such as helicity in the carbon network and
the nanometre diameters give the **nanotubes** a rich variety in
physical properties. Recent experimental progress on the measurements of
properties using electron-energy loss spectroscopy, Raman spectroscopy,
electron-spin resonance, electrical
conductance, mechanical stiffness and theoretical predictions on
electronic and mechanical properties of **nanotubes** are discussed.
In addition to **synthesis** techniques, methods to purify and make
aligned arrays of **nanotubes** are described. Different approaches
for **fabricating** composite structures using **nanotubes**
as moulds and templates and their future implications in materials science
are evaluated. Finally, promising areas of future applications, for
example as tiny field-emitting devices, micro-electrodes, nanoprobes and
hydrogen storage material are outlined.

CC A6146 Solid clusters (including fullerenes) and nanoparticles; A6480G
Microstructure; A6116N EPR and NMR determinations of structures

CT CARBON; EPR SPECTROSCOPY; NANOSTRUCTURED MATERIALS; NANOTECHNOLOGY; RAMAN
SPECTROSCOPY

ST nanometre-size tubes; **carbon nanotubes; single-shell**
nanotubes; graphene cylinders; **multishell nanotubes**;
concentric cylinders; graphene layers; helicity; electron-energy loss
spectroscopy; Raman spectroscopy; **electron-spin resonance**;
electrical conductance; mechanical stiffness; mechanical properties;
composite structures; field-emitting devices; micro-electrodes;
nanoprobes; hydrogen storage material; C

CHI C el

ET C

L62 ANSWER 11 OF 12 INSPEC (C) 2003 FIZ KARLSRUHE on STN

AN 1997:5735231 INSPEC DN A9723-6146-031

TI Carbon **nanotubes** films: electronic properties and their
application as field emitters.

AU de Heer, W.A.; Bonard, J.M.; Stoeckli, T.; Chatelain, A. (Dept. de Phys.,
Ecole Polytech. Federale de Lausanne, Switzerland); Forro, L.; Ugarte, D.

SO Zeitschrift fur Physik D (Atoms, Molecules and Clusters) **(May
1997)** vol.40, no.1-4, p.418-20. 18 refs.
Published by: Springer-Verlag
CODEN: ZDACE2 ISSN: 0178-7683
SICI: 0178-7683(199705)40:1/4L.418:CNFE;1-T
Conference: Eighth International Symposium on Small Particles and
Inorganic Clusters. Copenhagen, Denmark, 1-6 July 1996
Sponsor(s): Augustinus Fonden; Carlsbergfondet; Danish Center for
Nanostructures; Danfysk; et al

DT Conference Article; Journal

TC Experimental

CY Germany, Federal Republic of

LA English

AB Aligned carbon **nanotube** films have been studied with a wide
variety of characterization techniques. Although **nanotubes**
resemble bulk graphite as far as carrier densities, susceptibilities and
conductivities are concerned, transport properties and ESR measurements
indicate that carrier localization occurs at low temperatures.
Nanotube films are good field emitters **producing** large
currents at relatively low electric fields. The performance is superior to
the intensely studied **CVD** diamond films in particular for the
threshold field for electron emission. We believe that the observed
remarkable electron emission is related to the special electronic

structure of the **nanotube** tips.
CC A6146 Solid clusters (including fullerenes) and nanoparticles; A7360F Electronic properties of semiconductor thin films; A7970 Field emission and field ionization; A7630 Electron paramagnetic resonance and relaxation; A7540G Dynamic properties of magnetic materials; A7220F Low-field transport and mobility; piezoresistance (semiconductors/insulators); A7220J Charge carriers: generation, recombination, lifetime, and trapping (semiconductors/insulators)
CT ATOMIC CLUSTERS; CARBON; CARRIER DENSITY; ELECTRICAL CONDUCTIVITY; ELECTRON FIELD EMISSION; ELECTRONIC STRUCTURE; MAGNETIC SUSCEPTIBILITY; NANOSTRUCTURED MATERIALS; PARAMAGNETIC RESONANCE; SEMICONDUCTOR THIN FILMS
ST electron field emitters; **aligned carbon nanotube films**; carrier densities; magnetic susceptibility; electrical conductivity; ESR measurements; **electron spin resonance measurements**; carrier localization; threshold field; electronic structure; **nanotube tips** ; C
CHI C el
ET C

L62 ANSWER 12 OF 12 INSPEC (C) 2003 IEE on STN
AN 1997:5719576 INSPEC DN A9722-7630P-003
TI Room temperature **electron spin resonance** of the purified carbon **nanotubes produced** in different helium pressures.
AU Zhang Hai-yan (Dept. of Math. & Phys., Guangdong Univ. of Technol., Guangzhou, China); Wang Deng-yu; Xue Xin-min; He Yan-yang; Wu Ming-mei; Peng Shao-qi
SO Chinese Physics Letters **(1997)** vol.14, no.8, p.625-8. 12 refs.
Published by: Chinese Phys. Soc
Price: CCCC 0256-307X/97/$50.00
CODEN: CPLEEU ISSN: 0256-307X
SICI: 0256-307X(1997)14:8L.625:RTES;1-G
DT Journal
TC Experimental
CY China
LA English
AB The **electron spin resonance** (ESR) of purified carbon **nanotubes** prepared under different helium pressures from 20.0 to 80.0 kPa in are discharge has been measured. The dependence of the ESR **spin** density, linewidth and g value of the purified **nanotubes** on the helium pressure is found. The electronic properties of purified **nanotubes** varying with He pressure are discussed.
CC A7630P EPR of conduction electrons; A6146 Solid clusters (including fullerenes) and nanoparticles
CT CARBON; EPR LINE BREADTH; G-FACTOR; NANOSTRUCTURED MATERIALS
ST **room temperature electron spin resonance; purified C-nanotubes; purified carbon nanotubes; ESR spin density**; linewidth; g value; 20 to 80 kPa; C
CHI C el
PHP pressure 2.0E+04 to 8.0E+04 Pa
ET He; C

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FYI only - dates are after 1999.

=> d L67 1-16 all

L67 ANSWER 1 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN
AN 2003(24):925 COMPENDEX
TI Feasibility studies of magnetic particle-embedded carbon **nanotubes** for perpendicular recording media.
AU Kuo, Cheng Tzu (Dept. of Materials Sci. and Eng. National Chiao Tung University, Hsinchu 300, Taiwan); Lin, Chao Hsun; Lo, An Ya
SO Diamond and Related Materials v 12 n 3-7 March/July 2003 2003.p 799-805
CODEN: DRMTE3 ISSN: 0925-9635
PY 2003
DT Journal
TC Theoretical; Experimental
LA English
AB Nano-sized magnetic particles were successfully used as the catalysts to **synthesize** magnetic metal-encapsulated carbon **nanotubes** **(CNTs)** or nanoparticles on Si wafers in a **microwave** plasma electron cyclotron resonance **chemical vapor deposition** **(ECR-CVD)** system with CH4 and/or H2 as source gases. The magnetic catalyst materials, including Fe-Pt, Co-Pt, Nd2Fe14 B, Fe and Fe-Ni, were first deposited on Si wafers by a physical vapor deposition (PVD) method, with subsequent plasma treatment for nanoparticle transformation. The main process parameters include catalyst materials, hydrogen plasma catalyst pretreatment and deposition temperature. For applications in magnetic media, the process has the following advantages: perpendicularly aligned **CNTs** or nanoparticles; tip-growth **CNTs**; well-distributed magnetic particles; detectable magnetic field in each particle; high tube number density (up to 134 Gtubes/inch2 for Fe-assisted **CNTs**); favorable catalyst size; higher shape and induced anisotropy; and nanostructures that can be manipulated. The catalyst particle sizes of Fe, Nb2Fe14B and Fe-Pt (35-40 nm in diameter) are uniform and greater than but close to the critical optimum size or single domain size, which favor a higher coercive force. The greatest coercive force can reach 750 Oe for Fe-assisted **CNTs** at a deposition temperature of 715 deg C, which is comparable with values reported in the literature. The coercive force difference between the vertical and horizontal directions can reach 300 Oe for Fe-assisted **CNTs**, and 355 Oe for Nb2Fe14 B-assisted **CNTs**
. $CPY 2002 Elsevier Science B.V. 15 Refs.
CC 933.1 Crystalline Solids; 708.4 Magnetic Materials; 714.2 Semiconductor Devices and Integrated Circuits; 802.2 Chemical Reactions; 803 Chemical Agents; 804 Chemical Products Generally
CT *Carbon **nanotubes**; Silicon wafers; **Chemical vapor deposition**; Magnetic recording; Anisotropy; Electron cyclotron resonance; Catalysts; Magnetic materials
ST Magnetic catalysts
ET Si; H; Fe*Pt; Fe sy 2; sy 2; Pt sy 2; Fe-Pt; Co*Pt; Co sy 2; Co-Pt; Fe*Nd; Nd sy 2; Nd2Fe; Nd cp; cp; Fe cp; Fe; Fe*Ni; Ni sy 2; Fe-Ni; B*Fe*Nb; B sy 3; sy 3; Fe sy 3; Nb sy 3; Nb2Fe14B; Nb cp; B cp; Fe*Nb; Nb sy 2; Nb2Fe

L67 ANSWER 2 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN
AN 2003(8):5280 COMPENDEX
TI Template-directed **CVD** of dielectric **nanotubes**.
AU Zambov, Ludmil (Dow Corning Corporation Mail # CO41B1, Midland, MI 48686-0994, United States); Zambova, Adriana; Cabassi, Marco; Mayer, Theresa S.
SO Advanced Materials v 15 n 1 Jan 3 2003 2003.p 26-33
CODEN: ADVMEW ISSN: 0935-9648
PY 2003
DT Journal

TC Theoretical; Experimental
LA English
AB **Fabrication** of dielectric **nanotubes** from silicon dioxide and silicon nitride by a template-based electron cyclotron resonance (**ECR**) plasma-enhanced (PE) **CVD** is described. The **nanotubes synthesized** from SiH4-O2 and SiH4-N2 binary source reagent systems are smooth, transparent and at least 10 mum long. A mathematical description of the template-directed nanometer-scale **CVD** is developed to elucidate the appropriate process parameters that enable growth of high-aspect-ratio **nanotubes** with uniform wall thickness. The analysis of the model, by establishing general trends between process operating conditions and geometrical characteristics of the **nanotubes**, clarifies the mechanism of nanoscale **CVD** . The dielectric **nanotubes** obtained provide many opportunities for **fabricating** composite nanostructures and nanodevices. 49 Refs.
CC 802.2 Chemical Reactions; 932.3 Plasma Physics; 933.1 Crystalline Solids; 708.1 Dielectric Materials; 931.3 Atomic and Molecular Physics; 921 Applied Mathematics
CT *Plasma enhanced **chemical vapor deposition**; Dielectric materials; **Nanotubes**; Mathematical techniques; Electron cyclotron resonance; Composite materials
ST Nanodevices
ET H*Si; SiH; Si cp; cp; H cp; O; N

L67 ANSWER 3 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN
AN 2003(1):6178 COMPENDEX
TI Growth of the large area horizontally-aligned carbon **nanotubes** by **ECR-CVD**.
AU Hsu, Chih Ming (Dept. of Mat. Sci. and Engineering National Chiao Tung University, Hsinchu 300, Taiwan); Lin, Chao Hsun; Chang, Hui Lin; Kuo, Cheng Tzu
SO Thin Solid Films v 420-421 Dec 2 2002 2002.p 225-229
CODEN: THSFAP ISSN: 0040-6090
PY 2002
DT Journal
TC Theoretical; Experimental
LA English
AB For potential applications of carbon **nanotubes** (**CNTs**) as connectors in microelectronic devices, the process to **synthesize** the large area horizontally-aligned **CNTs** on 100 mm (4 inch) Si wafers was developed, using electron cyclotron resonance **chemical vapor deposition**, with CH 4 and H2 as the source gases and Co as the catalyst. The results show that vertical and horizontal **CNTs** can be obtained by manipulating the electric field applied on the substrate and flow direction of the gases. In the present deposition conditions, the horizontal **CNTs** show better field emission properties than vertical **CNTs**. This may be due to the blocking effect of catalysts at the tips and to the diminishment of the effective emission area from defects of vertical **CNTs** body. $CPY 2002 Elsevier Science B.V. All rights reserved. 34 Refs.
CC 933.1 Crystalline Solids; 713 Electronic Circuits; 802.2 Chemical Reactions; 714.2 Semiconductor Devices and Integrated Circuits; 931.2 Physical Properties of Gases, Liquids and Solids; 803 Chemical Agents
CT *Carbon **nanotubes**; **Synthesis** (chemical); Silicon wafers; Gases; Catalysts; Electron cyclotron resonance; Scanning electron microscopy; Microelectronics; **Chemical vapor deposition**
ST Electron cyclotron resonance **chemical vapor**

deposition (ECR-CVD)
ET Si; H; Co

L67 ANSWER 4 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN
AN 2003(1):6176 COMPENDEX
TI Effect of bias voltage on the formation of a-C:N nanostructures in **ECR** plasmas.
AU Liu, X.W. (Dept. of Mat. Sci. and Engineering National Tsing Hua University, Hsinchu 300, Taiwan); Chan, L.H.; Hong, K.H.; Shih, H.C.
SO Thin Solid Films v 420-421 Dec 2 2002 2002.p 212-218
CODEN: THSFAP ISSN: 0040-6090
PY 2002
DT Journal
TC Theoretical; Experimental
LA English
AB Amorphous carbon nitride (a-C:N) **nanotubes** and **nanofibers** on porous alumina templates were **synthesized** by an electron cyclotron resonance **chemical vapor deposition** system in which a variable negative d.c. bias was applied to the substrate holder of graphite to promote the flow of ionic fluxes through the nano-channels of the alumina template in **microwave** excited plasmas of C2H2 or N2. The aligned structures of a-C:N **nanotubes** or **nanofibers** were verified by field emission scanning electron microscopy. Transmission electron microscopy micrographs showed that a-C:N **nanotubes** and **nanofibers** were the size with a diameter of [similar to] 100-250 nm and a length of [similar to] 50-80 mum. The amorphous nature of the nanostructures was confirmed by the absence of crystalline phases arising from selected area diffraction patterns. X-ray photoelectron spectroscopy spectra indicated that a-C:N **nanotubes** and **nanofibers** were composed of nitrogen and carbon, and the N/C ratios could reach as high as 72%. The absorption bands between 1250 and 1750 cm-1 in Fourier transform infrared spectroscopy provided direct evidence for the presence of nitrogen atoms in the amorphous carbon network. The well-aligned a-C:N **nanotubes** and **nanofibers** are expected to have potential applications in optical, electronic and optoelectronic devices. $CPY 2002 Elsevier Science B.V. All rights reserved. 43 Refs.
CC 933.1 Crystalline Solids; 701.1 Electricity: Basic Concepts and Phenomena; 802.2 Chemical Reactions; 932.3 Plasma Physics; 931.3 Atomic and Molecular Physics; 741.3 Optical Devices and Systems
CT *Nanostructured materials; **Synthesis** (chemical); **Chemical vapor deposition**; Electric potential; Electron cyclotron resonance; Transmission electron microscopy; Plasma applications; Carbon **nanotubes**
ST **Nanofibers**
ET C*N; C:N; N doping; doped materials; C*H; C2H; C cp; cp; H cp; N

L67 ANSWER 5 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN
AN 2002(29):210 COMPENDEX
TI Morphology and characterization of highly nitrogenated, aligned, amorphous carbon nano-rods formed on an alumina template by **ECR-CVD**.
AU Liu, X.W. (Department of Materials Science/Eng. National Tsing Hua University, Hsinchu 300, Taiwan); Lin, J.H.; Hsieh, W.J.; Shih, H.C.
SO Diamond and Related Materials v 11 n 3-6 March/June 2002 2002.p 1193-1199
CODEN: DRMTE3 ISSN: 0925-9635
PY 2002
DT Journal
TC Experimental
LA English

AB Highly nitrogenated amorphous carbon (a-C:N) nano-rods on a porous alumina template were **synthesized** using an electron cyclotron resonance **chemical vapor deposition** (**ECR-CVD**) system, in which a negative DC bias was applied to the graphite substrate holder to promote the flow of ionic fluxes through the nano-channels of the alumina template in a **microwave**-excited plasma of C2H2 and N 2 as precursors. The aligned structure of a-C:N nano-rods was verified by field-emission scanning electron microscopy (FE-SEM). Transmission electron microscopy (TEM) micrographs of a-C:N nano-rods showed that the nano-rods are well aligned with a diameter of approximately 100-250 nm and a length of approximately 50-80 mum. The amorphous nature of the nano-rods was confirmed by the absence of crystalline phases arising from selected-area diffraction (SAD) patterns. X-Ray photoelectron spectroscopy (XPS) spectra indicated that these nano-rods were composed of nitrogen and carbon, and the N/C ratios could reach as high as 56%. The absorption bands between 1250 and 1750 cm-1 in Fourier-transform infrared (FTIR) spectra provided direct evidence for the effective incorporation of nitrogen atoms into the atmorphous carbon network. Raman spectra showed the same feature, with a G-band at [similar to]1580 and a D-band at [similar to]1370 cm-1 in the amorphous carbon film. The well-aligned a-C:N nano-rods are expected to have potential applications in optic, electronic and optoelectronic devices. $CPY 2002 Elsevier Science B.V. All rights reserved. 36 Refs.

CC 933.1 Crystalline Solids; 933.2 Amorphous Solids; 802.2 Chemical Reactions; 931.2 Physical Properties of Gases, Liquids and Solids; 804 Chemical Products Generally; 804.2 Inorganic Components

CT *Carbon **nanotubes**; Graphite; Fluxes; Transmission electron microscopy; Substrates; **Chemical vapor deposition**; Electron cyclotron resonance; Amorphous materials; **Synthesis** (chemical); Morphology; Nitrogen; Alumina; Porous materials

ST Nitrogenation; Carbon nanorods

ET C*N; C:N; N doping; doped materials; C*H; C2H; C cp; cp; H cp; N; D

L67 ANSWER 6 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN

AN 2002(27):3428 COMPENDEX

TI Well-aligned carbon **nanofibers synthesized** by electron cyclotron resonance **chemical vapor deposition**

AU Hoshi, Fumiyuki (FCT Research Laboratory JFCC c/o NIMC, Ibaraki, Japan); Tsugawa, Kazuo; Goto, Akiko; Ishikura, Takefumi; Yamashita, Satoshi; Yumura, Motoo; Hirao, Takashi; Fujiwara, Shuzou; Koga, Yoshinori

MT Nanotubes and Related Materials.

ML Boston, MA, United States

MD 27 Nov 2000-30 Nov 2000

SO Materials Research Society Symposium - Proceedings v. 633 2001.p A621-A626
CODEN: MRSPDH ISSN: 0272-9172

PY 2001

MN 59215

DT Conference Article

TC Experimental

LA English

AB Aligned carbon **nanofibers** and hollow carbon **nanofibers** were grown by MW **ECR-CVD** method using methane and argon mixture gas at the temperature of 550deg C. Carbon **nanofibers** and hollow carbon **nanofibers** were deposited perpendicularly on Si substrate and on Si substrate coated with Ni catalyst, respectively. Raman spectra of aligned carbon **nanofibers** and hollow carbon **nanofibers** showed new bands of 1340 and 1612 cm-1 of the first-order Raman scattering and 2660, 2940 and 3220 cm-1 of

the second-order Rattan scattering. The second-order Raman scattering bands were assigned to two overtone and one combination bands on the basis of a similar assignment of micro crystal graphite. Combination bands are intense unusually. Field emitter characteristics of the well-aligned carbon **nanofibers** and hollow carbon **nanofibers** were invest/gated and the current densities were 7.25 mA/cm2 and 0.69 mA/cm2 at 12.5 V/ mum, respectively. 8 Refs.

CC 933.1 Crystalline Solids; 931.3 Atomic and Molecular Physics; 802.2 Chemical Reactions; 933.1.2 Crystal Growth; 804.1 Organic Components; 803 Chemical Agents

CT *Carbon **nanotubes**; Electron emission; Methane; Argon; Catalysts; Raman scattering; Band structure; Electron cyclotron resonance; **Chemical vapor deposition**; Crystal growth

ST Carbon **nanofibers**

ET Si; Ni

L67 ANSWER 7 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN

AN 2000(32):247 COMPENDEX

TI **Synthesis** and characterization of the aligned hydrogenated amorphous carbon **nanotubes** by electron cyclotron resonance excitation.

AU Tsai, S.H. (Natl Tsing Hua Univ, Hsinchu, Taiwan); Chiang, F.K.; Tsai, T.G.; Shieu, F.S.; Shih, H.C.

SO Thin Solid Films v 366 n 1-2 May 1 2000 p 11-15
CODEN: THSFAP ISSN: 0040-6090

PY 2000

DT Journal

TC Experimental

LA English

AB Aligned hydrogenated amorphous carbon **nanotubes** on porous anodic alumina have been **synthesized** by electron cyclotron resonance **chemical vapor deposition** (**ECR-CVD**) using the precursor gases, acetylene and argon. The composite film, with the aligned hydrogenated amorphous carbon **nanotubes** embedded in the porous anodic alumina, was found to be robust and is expected to have potential application in optic, electronic and optoelectronic devices. It is possible to prepare a large area of such a film by taking advantages of the **ECR-CVD** process, e.g.high plasma density at low temperature, less ionic damage, contamination-free and high deposition rate. By adjusting the pore size of anodic alumina, hydrogenated amorphous carbon **nanotubes** of various diameters can be **produced** in a range from 230 down to 30 nm. Characterization of the **nanotubes** in anodic alumina was carried out by field emission scanning electron microscopy (FESEM), Fourier transform infrared spectroscopy (FTIR), transmission electronic microscopy (TEM) and electron energy loss spectroscopy (EELS). The results indicate that the **nanotubes** consist of amorphous hydrogenated carbon, which are grown at a temperature of approx.100 degree C for 4 min. (Author abstract) 20 Refs.

CC 804.2 Inorganic Components; 933.1 Crystalline Solids; 933.2 Amorphous Solids; 802.2 Chemical Reactions; 931.3 Atomic and Molecular Physics; 804.1 Organic Components

CT *Carbon; Argon; Hydrogenation; Characterization; Electron cyclotron resonance; Alumina; **Chemical vapor deposition**; Acetylene; **Nanotubes**; Amorphous materials

ST Amorphous hydrogenated carbon; Porous anodic alumina; Composite film

ET C

L67 ANSWER 8 OF 16 INSPEC (C) 2003 IEE on STN

AN 2003:7654428 INSPEC DN A2003-14-6148-012

TI Effect of ion bombardment on microstructures of carbon **nanotubes** grown by electron cyclotron resonance **chemical vapor deposition** at low temperatures.
AU Yun-Sung Woo (Dept. of Mater. Sci. & Eng., Korea Adv. Inst. of Sci. & Technol., Taejon, South Korea); In-Taek Han; Young-Jun Park; Ha-Jin Kim; Jae-Eun Jung; Nae-Sung Lee; Duk-Young Jeon; Kim, J.M.
SO Japanese Journal of Applied Physics, Part 1 (Regular Papers, Short Notes & Review Papers) (March 2003) vol.42, no.3, p.1410-13. 22 refs.
Published by: Japan Soc. Appl. Phys
CODEN: JAPNDE ISSN: 0021-4922
SICI: 0021-4922(200303)42:3L.1410:EBMC;1-X
DT Journal
TC Experimental
CY Japan
LA English
AB Vertically aligned multi walled carbon **nanotubes** (**MWNTs**) were **synthesized** by electron cyclotron resonance **chemical vapor deposition** on Ni-coated glass substrates at temperatures as low as 400 degrees C. Negative self-biases were applied to the substrates by radio-frequency (RF) plasma for ion bombardment of the growing surface. It was observed that ion bombardment by RF biasing to the substrates had a great effect upon the growth of carbon **nanotubes** and their morphologies. High-resolution transmission electron microscopy revealed that the degree of ordering of graphene layers in the **synthesized nanotubes** increased with RF bias. Raman spectroscopic analyses indicated that the shortening of C-C bonds within the graphene layers of the **MWNTs** occurred at larger negative biases, which seemed to result from removal of bonded hydrogen from the **MWNTs** by ion bombardment.
CC A6148 Structure of fullerenes and fullerene-related materials; A8115H Chemical vapour deposition; A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A6180J Ion beam effects; A7830G Infrared and Raman spectra in inorganic crystals
CT CARBON **NANOTUBES**; ION BEAM EFFECTS; PLASMA **CVD**; RAMAN SPECTRA; TRANSMISSION ELECTRON MICROSCOPY
ST **multiwalled carbon nanotubes**; **ECR-CVD**; Ni-coated glass substrates; RIF biasing; ion bombardment; HRTEM; graphene layers; Raman spectra; 400 degC; C
CHI C el
PHP temperature 6.73E+02 K
ET Ni; C; C-C

L67 ANSWER 9 OF 16 INSPEC (C) 2003 IEE on STN
AN 2003:7635573 INSPEC DN A2003-13-8115H-114
TI Growth of the large area horizontally-aligned carbon **nanotubes** by **ECR-CVD**.
AU Chih Ming Hsu; Chao Hsun Lin; Hui Lin Chang; Cheng Tzu Kuo (Dept. of Mater. Sci. & Eng., Nat. Chiao Tung Univ., Hsinchu, Taiwan)
SO Thin Solid Films (2 Dec. 2002) vol.420-421, p.225-9. 34 refs.
Doc. No.: S0040-6090(02)00799-X
Published by: Elsevier
Price: CCCC 0040-6090/02/$22.00
CODEN: THSFAP ISSN: 0040-6090
SICI: 0040-6090(20021202)420/421L.225:GLAH;1-B
Conference: 29th International Conference on Metallurgical Coatings and Thin Films. San Diego, CA, USA, 22-26 April 2002
DT Conference Article; Journal
TC Experimental
CY Switzerland
LA English

AB For potential applications of carbon **nanotubes** (**CNTs**) as connectors in microelectronic devices, the process to **synthesize** the large area horizontally-aligned **CNTs** on 100 mm (4 inch) Si wafers was developed, using electron cyclotron resonance **chemical vapor deposition**, with CH4 and H2 as the source gases and Co as the catalyst. The results show that vertical and horizontal **CNTs** can be obtained by manipulating the electric field applied on the substrate and flow direction of the gases. In the present deposition conditions, the horizontal **CNTs** show better field emission properties than vertical **CNTs**. This may be due to the blocking effect of catalysts at the tips and to the diminishment of the effective emission area from defects of vertical **CNTs** body.

CC A8115H Chemical vapour deposition; A6148 Structure of fullerenes and fullerene-related materials; A6865 Low-dimensional structures: growth, structure and nonelectronic properties; A7970 Field emission and field ionization

CT CARBON **NANOTUBES**; **CHEMICAL VAPOUR DEPOSITION**; CRYSTAL DEFECTS; FIELD EMISSION; SCANNING ELECTRON MICROSCOPY

ST **horizontally-aligned carbon nanotubes**; **ECR-CVD**; microelectronic devices; connectors; Co catalyst; field emission; blocking effect; defects; SEM; C; Si; Co

CHI C el; Si sur, Si el; Co el

ET Si; C*H; CH4; C cp; cp; H cp; H2; Co; C

L67 ANSWER 10 OF 16 INSPEC (C) 2003 IEE on STN

AN 2003:7635571 INSPEC DN A2003-13-8115H-113

TI Effect of bias voltage on the formation of a-C:N nanostructures in **ECR** plasmas.

AU Liu, X.W.; Chan, L.H.; Hong, K.H.; Shih, H.C. (Dept. of Mater. Sci. & Eng., Nat. Tsing Hua Univ., Hsinchu, Taiwan)

SO Thin Solid Films (2 Dec. 2002) vol.420-421, p.212-18. 43 refs.
Doc. No.: S0040-6090(02)00798-8
Published by: Elsevier
Price: CCCC 0040-6090/2002/$22.00
CODEN: THSFAP ISSN: 0040-6090
SICI: 0040-6090(20021202)420/421L.212:EBVF;1-D

DT Journal

TC Experimental

CY Switzerland

LA English

AB Amorphous carbon nitride (a-C:N) **nanotubes** and **nanofibers** on porous alumina templates were **synthesized** by an electron cyclotron resonance **chemical vapor deposition** system in which a variable negative d.c. bias was applied to the substrate holder of graphite to promote the flow of ionic fluxes through the nano-channels of the alumina template in **microwave** excited plasmas of C2H2 or N2. The aligned structures of a-C:N. **nanotubes** or **nanofibers** were verified by field emission scanning electron-microscopy. Transmission electron microscopy micrographs showed that a-C:N **nanotubes** and **nanofibers** were the size with a diameter of 100-250 nm and a length of 50-80 mu m. The amorphous nature of the nanostructures was confirmed by the absence of crystalline phases arising from selected area diffraction patterns. X-ray photoelectron spectroscopy spectra indicated that a-C:N **nanotubes** and **nanofibers** were composed of nitrogen and carbon, and the N/C ratios could reach as high as 72%. The absorption bands between 1250 and 1750 cm-1 in Fourier transform infrared spectroscopy provided direct evidence for the presence of nitrogen atoms in the amorphous carbon

network. The well-aligned a-C:N **nanotubes** and **nanofibers** are expected to have potential applications in optical, electronic and optoelectronic devices.

CC A8115H Chemical vapour deposition; A5275R Plasma applications in manufacturing and materials processing; A6146 Structure of solid clusters, nanoparticles, and nanostructured materials; A7830G Infrared and Raman spectra in inorganic crystals; A7960E Photoelectron spectra of semiconductors and insulators; A7125W Electronic structure of solid clusters and nanoparticles; A7820D Optical constants and parameters (condensed matter)

CT ABSORPTION COEFFICIENTS; AMORPHOUS STATE; BINDING ENERGY; CARBON COMPOUNDS; FIELD EMISSION ELECTRON MICROSCOPY; FOURIER TRANSFORM SPECTRA; INFRARED SPECTRA; **NANOTUBES**; PLASMA **CVD**; SCANNING ELECTRON MICROSCOPY; TRANSMISSION ELECTRON MICROSCOPY; X-RAY PHOTOELECTRON SPECTRA

ST bias voltage; a-C:N nanostructures formation; **ECR plasmas**; **amorphous carbon nitride nanotubes**; **nanofibers**; porous alumina templates; **electron cyclotron resonance chemical vapor deposition**; graphite substrate holder; ionic flux flow; **microwave excited plasma**; field emission scanning electron-microscopy; transmission electron microscopy; X-ray photoelectron spectroscopy; absorption bands; Fourier transform infrared spectroscopy; binding energy; 100 to 250 nm; 50 to 80 micron; C:N

CHI C:N bin, C bin, N bin, C el, N el, N dop

PHP size 1.0E-07 to 2.5E-07 m; size 5.0E-05 to 8.0E-05 m

ET C*N; C:N; N doping; doped materials; C*H; C2H2; C cp; cp; H cp; N2

L67 ANSWER 11 OF 16 INSPEC (C) 2003 IEE on STN

AN 2003:7612661 INSPEC DN A2003-12-8120V-027

TI Well-aligned carbon **nanofibers synthesized** by electron cyclotron resonance **chemical vapor deposition**
.

AU Hoshi, F.; Tsugawa, K.; Goto, A.; Ishikura, T. (FCT Res. Lab., Japan Fine Ceramics Center, Nagoya, Japan); Yamashita, S.; Yumura, M.; Hirao, T.; Fujiwara, S.; Koga, Y.

SO Nanotubes and Related Materials. Symposium (Mater. Res. Soc. Symposium Proceedings Vol.633)
Editor(s): Rao, A.M.
Warrendale, PA, USA: Mater. Res. Soc, 2001. p.A6.2.1-6 of xiii+320 pp. 8 refs.
Conference: Boston, MA, USA, 27-30 Nov 2000

DT Conference Article

TC Experimental

CY United States

LA English

AB Aligned carbon **nanofibers** and hollow carbon **nanofibers** were grown by MW **ECR-CVD** method using methane and argon mixture gas at the temperature of 550 degrees C. Carbon **nanofibers** and hollow carbon **nanofibers** were deposited perpendicularly on Si substrate and on Si substrate coated with Ni catalyst, respectively. Raman spectra of aligned carbon **nanofibers** and hollow carbon **nanofibers** showed new bands of 1340 and 1612 cm-1 of the first-order Raman scattering and 2660, 2940 and 3220 cm-1 of the second-order Raman scattering. The second-order Raman scattering bands were assigned to two overtone and one combination bands on the basis of a similar assignment of micro crystal graphite. Combination bands arc intense unusually. Field emitter characteristics of the well-aligned carbon **nanofibers** and hollow carbon **nanofibers** were investigated and the current densities were 7.25 mA/cm2 and 0.69 mA/cm2 at 12.5 V/ mu m, respectively.

CC A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A6146 Structure of solid clusters, nanoparticles, and nanostructured materials; A7830G Infrared and Raman spectra in inorganic crystals
CT CARBON FIBRES; **CHEMICAL VAPOUR DEPOSITION;** CURRENT DENSITY; NANOSTRUCTURED MATERIALS; RAMAN SPECTRA; SCANNING ELECTRON MICROSCOPY; TRANSMISSION ELECTRON MICROSCOPY
ST **carbon nanofibers; electron cyclotron resonance chemical vapor deposition; ECR CVD;** methane; argon mixture gas; **hollow carbon nanofibers;** Ni catalyst; Raman spectra; first order Raman scattering bands; second order Raman scattering bands; overtone bands; combination bands; field emitter characteristics; current densities; micro crystal graphite; 550 C; 1340 cm-1; 1612 cm-1; 2660 cm-1; 2940 cm-1; 3220 cm-1; C; Ni; Si
CHI C el; Ni el; Si sur, Si el
PHP temperature 8.23E+02 K; wavelength 7.46E-06 m; wavelength 6.203E-06 m; wavelength 3.76E-06 m; wavelength 3.40E-06 m; wavelength 3.11E-06 m
ET C; Si; Ni

L67 ANSWER 12 OF 16 INSPEC (C) 2003 IEE on STN
AN 2002:7363088 INSPEC DN A2002-20-8120V-004
TI Growth mechanism and properties of the large area well-aligned carbon nano-structures deposited by **microwave** plasma electron cyclotron resonance **chemical vapor deposition.**
AU Chao Hsun Lin; Hui Lin Chang; Ming Her Tsai; Cheng Tzu Kuo (Dept. of Mater. Sci. & Eng., Nat. Chiao Tung Univ., Hsinchu, Taiwan)
SO Diamond and Related Materials (March-June 2002) vol.11, no.3-6, p.922-6. 17 refs.
Doc. No.: S0925-9635(01)00640-9
Published by: Elsevier
Price: CCCC 0925-9635/02/$22.00
CODEN: DRMTE3 ISSN: 0925-9635
SICI: 0925-9635(200203/06)11:3/6L.922:GMPL;1-K
Conference: 12th European Conference on Diamond, Diamond-like Materials, Carbon Nanotubes, Nitrides and Silicion Carbide (Diamond 2001). Budapest, Hungary, 2-7 Sept 2001
DT Conference Article; Journal
TC Experimental
CY Netherlands
LA English
AB Large area (4-inch diameter) well-aligned carbon nano-structures on Si substrate were successfully **synthesized** by using a catalyst-assisted **microwave** plasma electron cyclotron resonance **chemical vapor deposition (ECR-CVD)** system with CH4 as source gas. The catalysts include Fe, Co and Ni. The catalysts and the deposited nano-structures were characterized by scanning electron microscopy (SEM), transmission electron microscopy (TEM), Raman and field emission I-V measurements. Effects of process parameters on morphologies, structures and properties of the nano-structures were examined. The results show that the deposited nano-structures can include normal **nano-tubes**, split catalyst **nano-tubes**, seaweed-like **nano**-sheets and carbon film, depending mainly on substrate temperature and bias, catalyst materials and their application methods. Deposition mechanisms for different nano-structures, especially, the unique split catalyst **nano-tubes** and seaweed-like nano-sheets, were proposed. The differences in oxidation resistance and field emission properties between different nano-structures will be compared and discussed.
CC A8120V Preparation of fullerenes and fullerene-related materials,

intercalation compounds, and diamond; A5275R Plasma applications in manufacturing and materials processing; A6148 Structure of fullerenes and fullerene-related materials; A8230V Homogeneous catalysis; A7970 Field emission and field ionization

CT CARBON **NANOTUBES**; CATALYSIS; ELECTRON FIELD EMISSION; OXIDATION; PLASMA **CVD**; RAMAN SPECTRA; SCANNING ELECTRON MICROSCOPY; TRANSMISSION ELECTRON MICROSCOPY

ST large area well-aligned carbon nanostructures; growth mechanism; **microwave plasma ECR CVD**; catalyst-assisted processes; scanning electron microscopy; transmission electron microscopy; Raman measurements; field emission I-V measurements; morphologies; **normal nanotubes**; **split catalyst nanotubes**; seaweed-like nanosheets; substrate temperature; substrate bias; oxidation resistance; field emission properties; C

CHI C sur, C el

ET Si; C*H; CH4; C cp; cp; H cp; Fe; Co; Ni; I*V; I-V; C

L67 ANSWER 13 OF 16 INSPEC (C) 2003 IEE on STN

AN 2002:7325665 INSPEC DN A2002-17-0130C-009; B2002-08-0100-096

TI Diamond, Diamond-Like Carbon and Related Materials. Symposium F of the International Conference on Materials for Advanced Technologies 2001.

SO International Journal of Modern Physics B (20 March 2002) vol.16, no.6-7
Published by: World Scientific
CODEN: IJPBEV ISSN: 0217-9792
Conference: Diamond, Diamond-Like Carbon and Related Materials. Symposium F of the International Conference on Materials for Advanced Technologies 2001. Singapore, 1-6 July 2001

DT Conference Proceedings; Journal

CY Singapore

LA English

AB The following topics were dealt with: pulsed laser deposition; vacuum arc plasma deposition; diamond; plasma **CVD**; carbon **nanotubes** ; DC magnetron sputtering; UV photodetectors; diffusion barriers; cathodic electrodeposition; crystallites **synthesis**; optical protective coatings; diamond detectors; **ECR-CVD**; **PECVD**; DLC coating tribology; magnetic storage media; flat panel displays; electron field emission; thermoluminescent dosimeters; antireflection coatings; STM; thermal conductivity and carbon nanocomposite films.

CC A0130C Conference proceedings; A8115I Pulsed laser deposition; A6855 Thin film growth, structure, and epitaxy; A8115G Vacuum deposition; A6148 Structure of fullerenes and fullerene-related materials; A6480G Microstructure; A5275R Plasma applications in manufacturing and materials processing; A8115H Chemical vapour deposition; A8115C Deposition by sputtering; A6220P Tribology; A8140P Friction, lubrication, and wear; A6670 Nonelectronic thermal conduction and heat-pulse propagation in nonmetallic solids; A7970 Field emission and field ionization; A8760M Radiation dosimetry in medical physics; A4280X Optical coatings; A0762 Detection of radiation (bolometers, photoelectric cells, i.r. and submillimetre waves detection); A8115L Deposition from liquid phases (melts and solutions); A8245 Electrochemistry and electrophoresis; B0100 General electrical engineering topics; B2520C Elemental semiconductors; B0520H Pulsed laser deposition; B0520D Vacuum deposition; B0520F Chemical vapour deposition; B0520B Sputter deposition; B2320 Electron emission, materials and cathodes; B7530B Radiation protection and dosimetry; B4190F Optical coatings and filters; B4110 Optical materials; B7230C Photodetectors; B0520J Deposition from liquid phases; B0550 Composite materials (engineering materials science); B7260B Display materials

CT ANTIREFLECTION COATINGS; CARBON; CARBON **NANOTUBES**; COMPOSITE MATERIALS; CRYSTALLITES; DIAMOND; DIFFUSION BARRIERS; ELECTRODEPOSITION; ELECTRON FIELD EMISSION; ELEMENTAL SEMICONDUCTORS; FLAT PANEL DISPLAYS;

MAGNETIC STORAGE; OPTICAL FILMS; PHOTODETECTORS; PLASMA **CVD**; PULSED LASER DEPOSITION; SEMICONDUCTOR GROWTH; SPUTTER DEPOSITION; THERMAL CONDUCTIVITY; THERMOLUMINESCENT DOSIMETERS; TRIBOLOGY; ULTRAVIOLET DETECTORS; VACUUM DEPOSITION
ST diamond-like C; pulsed laser deposition; vacuum arc plasma deposition; diamond; **plasma CVD**; **C nanotubes**; DC magnetron sputtering; UV photodetectors; diffusion barriers; cathodic electrodeposition; **crystallites synthesis**; optical protective coatings; diamond detectors; **ECR-CVD**; **PECVD**; DLC coating; tribology; magnetic storage media; flat panel displays; electron field emission; thermoluminescent dosimeters; antireflection coatings; STM; thermal conductivity; C nanocomposite films; C
CHI C el
ET F; C

L67 ANSWER 14 OF 16 INSPEC (C) 2003 IEE on STN
AN 2001:6896573 INSPEC DN A2001-10-7970-004; B2001-05-2320-008
TI Field emission and structure of aligned carbon **nanofibers** deposited by **ECR-CVD** plasma method.
AU Hoshi, F.; Tsugawa, K.; Goto, A.; Ishikura, T. (NIMC, Joint Res. Consortium of Frontier Carbon Technol., Ibaraki, Japan); Yamashita, S.; Yamura, M.; Hirao, T.; Oura, K.; Koga, Y.
SO Diamond and Related Materials (Feb. 2001) vol.10, no.2, p.254-9. 11 refs.
Doc. No.: S0925-9635(00)00476-3
Published by: Elsevier
Price: CCCC 0925-9635/2001/$20.00
CODEN: DRMTE3 ISSN: 0925-9635
SICI: 0925-9635(200102)10:2L.254:FESA;1-2
Conference: 3rd Specialist Meeting on Amorphous Carbon (SMAC 2000). Mondovi, Italy, 30 Aug-1 Sept 2000
DT Conference Article; Journal
TC Experimental
CY Switzerland
LA English
AB Aligned carbon **nanofibers** and hollow carbon **nanofibers** were grown by MW **ECR-CVD** method using methane and argon mixture gas at a temperature of 550 degrees C. The carbon **nanofibers** and the hollow carbon **nanofibers** were deposited perpendicularly on Si substrates and on Si substrates coated with Ni catalyst, respectively. From TEM analysis the diameter and length of the **nanofibers** are approximately 60 nm and 15 pm, respectively Raman spectra of these aligned carbon **nanofibers** showed new bands of 1340 and 1612 cm-1 of the first-order Raman scattering and 2660, 2940 and 3220 cm-1 of the second-order Raman scattering. The second-order Raman scattering bands were assigned to two overtone and one combination bands on the basis of a similar assignment of micro-crystal graphite by Nemanich and Solin. By the measurement of XPS C1s band energies of 284.6 eV for the carbon **nanofiber** and 284.7 eV for the hollow carbon **nanofiber** indicate mainly sp2 carbon component in the inclusion of a small amount (<5%) of oxygen in a high binding energy region (-288 eV). Field emission characteristics of the well-aligned carbon **nanofibers** and hollow carbon **nanofibers** were investigated and the current densities were 7.25 and 0.69 mA/cm2 at 12.5 V/ mu m, respectively.
CC A7970 Field emission and field ionization; A6148 Structure of fullerenes and fullerene-related materials; A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A5275R Plasma applications in manufacturing and materials processing; A6855 Thin film growth, structure, and epitaxy; A8115H Chemical vapour deposition; A8265J Heterogeneous catalysis at surfaces and other surface reactions;

A6322 Phonons in low-dimensional structures and small particles; A7960G Photoelectron spectra of composite surfaces; A7830G Infrared and Raman spectra in inorganic crystals; A7865V Optical properties of fullerenes and related materials (thin films/low-dimensional structures); B2320 Electron emission, materials and cathodes; B0587 Fullerenes, carbon nanotubes, and related materials (engineering materials science); B0520F Chemical vapour deposition

CT CARBON **NANOTUBES**; CATALYSTS; CRYSTAL STRUCTURE; CURRENT DENSITY; ELECTRON FIELD EMISSION; NICKEL; PHONON SPECTRA; PLASMA **CVD**; RAMAN SPECTRA; TRANSMISSION ELECTRON MICROSCOPY; X-RAY PHOTOELECTRON SPECTRA

ST field emission; structure; **aligned carbon nanofibers**; **ECR-CVD plasma method**; **hollow carbon nanofibers**; **MW ECR-CVD method**; methane; argon; **carbon nanofibers**; Si substrates; Ni catalyst; TEM; Raman spectra; first-order Raman scattering; second-order Raman scattering; XPS C1s band energies; sp2 carbon component; current densities; 550 C; 60 nm; 15 mum; 1340 to 3220 cm-1; C; Si; Ni

CHI C el; Si sur, Si el; Ni sur, Ni el

PHP temperature 8.23E+02 K; size 6.0E-08 m; size 1.5E-05 m; wavelength 3.11E-06 to 7.46E-06 m

ET C; Si; Ni

L67 ANSWER 15 OF 16 INSPEC (C) 2003 FIZ KARLSRUHE on STN

AN 2000:6642970 INSPEC DN A2000-16-8120V-007

TI **Synthesis** and characterization of the aligned hydrogenated amorphous carbon **nanotubes** by electron cyclotron resonance excitation

AU Tsai, S.H. (Dept. of Mater. Sci. & Eng., Nat. Tsing Hua Univ., Hsinchu, Taiwan); Chiang, F.K.; Tsai, T.G.; Shieu, F.S.; Shih, H.C.

SO Thin Solid Films (1 May 2000) vol.366, no.1-2, p.11-15. 20 refs.
Doc. No.: S0040-6090(99)01105-0
Published by: Elsevier
Price: CCCC 0040-6090/2000/$20.00
CODEN: THSFAP ISSN: 0040-6090
SICI: 0040-6090(20000501)366:1/2L.11:SCAH;1-X

DT Journal

TC Experimental

CY Switzerland

LA English

AB Aligned hydrogenated amorphous carbon **nanotubes** on porous anodic alumina have been **synthesized** by electron cyclotron resonance **chemical vapor deposition (ECR-CVD)** using the precursor gases, acetylene and argon. The composite film, with the aligned hydrogenated amorphous carbon **nanotubes** embedded in the porous anodic alumina, was found to be robust and is expected to have potential application in optic, electronic and optoelectronic devices. It is possible to prepare a large area of such a film by taking advantages of the **ECR-CVD** process, e.g. high plasma density at low temperature, less ionic damage, contamination-free and high deposition rate. By adjusting the pore size of anodic alumina, hydrogenated amorphous carbon **nanotubes** of various diameters can be **produced** in a range from 230 down to 30 nm. Characterization of the **nanotubes** in anodic alumina was carried out by field emission scanning electron microscopy (FESEM), Fourier transform infrared spectroscopy (FTIR), transmission electronic microscopy (TEM) and electron energy loss spectroscopy (EELS). The results indicate that the **nanotubes** consist of amorphous hydrogenated carbon, which are grown at a temperature of 100 degrees C for 4 min.

CC A8120V Preparation of fullerenes and fullerene-related materials,

intercalation compounds, and diamond; A7830L Infrared and Raman spectra in disordered solids; A7920K Other electron-surface impact phenomena; A8115H Chemical vapour deposition; A6148 Structure of fullerenes and fullerene-related materials; A7865V Optical properties of fullerenes and related materials (thin films/low-dimensional structures)

CT ALUMINA; AMORPHOUS STATE; CARBON **NANOTUBES**; COMPOSITE MATERIALS; ELECTRON ENERGY LOSS SPECTRA; FIELD EMISSION ELECTRON MICROSCOPY; FOURIER TRANSFORM SPECTRA; HYDROGEN; INFRARED SPECTRA; PLASMA **CVD**; PLASMA **CVD** COATINGS; POROUS MATERIALS; SCANNING ELECTRON MICROSCOPY; TRANSMISSION ELECTRON MICROSCOPY

ST **carbon nanotubes**; hydrogenated amorphous carbon; electron cyclotron resonance excitation; alumina substrate; **CVD**; **chemical vapour deposition**; composite film; porous anodic alumina; plasma density; deposition rate; SEM; scanning electron microscopy; FTIR; TEM; transmission electron microscopy; EELS; electron energy loss spectroscopy; temperature dependence; 30 to 230 nm; C:H; Al2O3

CHI C:H bin, C bin, H bin, C el, H el, H dop; Al2O3 bin, Al2 bin, Al bin, O3 bin, O bin

PHP size 3.0E-08 to 2.3E-07 m

ET C; C*H; C:H; H doping; doped materials; Al*O; Al2O3; Al cp; cp; O cp; Al2O; Al; O

L67 ANSWER 16 OF 16 INSPEC (C) 2003 IEE on STN

AN 2000:6517297 INSPEC DN A2000-07-6146-015

TI A novel form of carbon nitrides: well-aligned carbon nitride **nanotubes** and their characterization.

AU Sung, S.L.; Tsai, S.H.; Liu, X.W.; Shih, H.C. (Dept. of Mater. Sci. & Eng., Nat. Tsing Hua Univ., Hsinchu, Taiwan)

SO Journal of Materials Research (Feb. 2000) vol.15, no.2, p.502-10. 47 refs.
Published by: Mater. Res. Soc
Price: CCCC 0884-2914/2000/$2.50
CODEN: JMREEE ISSN: 0884-2914
SICI: 0884-2914(200002)15:2L.502:NFCN;1-0

DT Journal

TC Experimental

CY United States

LA English

AB Well-aligned carbon nitride **nanotubes** were prepared with a porous alumina membrane as a template when using electron cyclotron resonance (**ECR**) plasma in a mixture of C2H2 and N2 as the precursor with an applied negative bias to the graphite sample holder. The hollow structure and good alignment of the **nanotubes** were verified by field-emission scanning electron microscopy. Carbon nitride **nanotubes** were transparent when viewed by transmission electron microscopy, which showed that the **nanotubes** were hollow with a diameter of about 250 nm and a length of about 50-80 mu m. The amorphous nature of the **nanotubes** was confirmed by the absence of crystalline phases arising from selected-area diffraction patterns. Both Auger electron microscopy and X-ray photoelectron spectroscopy spectra indicated that these **nanotubes** are composed of nitrogen and carbon. The total N/C ratio is 0.72, which is considerably higher than other forms of carbon nitrides. No free-carbon phase was observed in the amorphous carbon nitride **nanotubes**, The absorption bands between 1250 and 1750 cm-1 in Fourier transform infrared spectroscopy provided direct evidence for nitrogen atoms, effectively incorporated within the amorphous carbon network. Such growth of well-aligned carbon nitride **nanotubes** can be controlled by tuning the **ECR** plasma conditions and the applied negative voltage to the alumina template.

CC A6146 Structure of solid clusters, nanoparticles, and nanostructured materials; A8115H Chemical vapour deposition; A7960E Photoelectron spectra

of semiconductors and insulators; A6116D Electron microscopy determinations of structures; A7920F Electron-surface impact: Auger emission; A7830L Infrared and Raman spectra in disordered solids; A5275R Plasma applications in manufacturing and materials processing

CT AMORPHOUS STATE; AUGER ELECTRON SPECTRA; CARBON COMPOUNDS; CYCLOTRON RESONANCE; ELECTRON DIFFRACTION; FIELD EMISSION ELECTRON MICROSCOPY; FOURIER TRANSFORM SPECTRA; INFRARED SPECTRA; NANOSTRUCTURED MATERIALS; PLASMA **CVD**; SCANNING ELECTRON MICROSCOPY; TRANSMISSION ELECTRON MICROSCOPY; X-RAY PHOTOELECTRON SPECTRA

ST **well-aligned CN nanotubes**; porous alumina membrane; electron cyclotron resonance plasma; template; N2; precursor; applied negative bias; graphite sample holder; hollow structure; field-emission scanning electron microscopy; transmission electron microscopy; diameter; amorphous nature; crystalline phases; selected-area diffraction patterns; Auger electron microscopy; X-ray photoelectron spectroscopy spectra; **amorphous CN nanotubes**; absorption bands; Fourier transform infrared spectroscopy; amorphous C network; applied negative voltage; CN

CHI N2 el, N el; CN bin, C bin, N bin

ET C*H; C2H2; C cp; cp; H cp; N2; C*N; CN; N cp; C; N